

# FINAL REPORT

## VINELAND CHEMICAL SUPERFUND SITE: PERIODIC SAMPLING – FALL 2009 OPERABLE UNITS #3 AND #4 VINELAND, NEW JERSEY

Prepared for:



U.S. Army Corps of Engineers, Philadelphia District  
Wanamaker Building  
100 Penn Square East  
Philadelphia, Pennsylvania 19107

Prepared by:



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March 2010

EA Project No. 62305.01

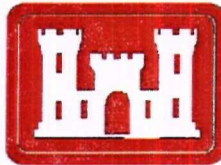
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## LIST OF ABBREVIATIONS, ACRONYMS, AND UNITS

ADR	Automated Data Review
ASTM	American Society for Testing and Materials
°C	Degrees Celsius
COC	Chain of Custody
DESA	Division of Environmental Science and Assessment
DGPS	Differential Global Positioning System
EA	EA Engineering, Science, and Technology, Inc.
EDDs	Electronic Data Deliverables
EM	Engineer Manual
ft	Foot/Feet
HNO <sub>3</sub>	Nitric acid
in	Inch(es)
MDL	Method Detection Limit
mg/Kg	Milligram(s) Per Kilogram (ppm)
mg/L	Milligram(s) Per Liter
mL	Milliliter(s)
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD83	North American Datum 1983
NJ	New Jersey
ND	Non-detect
ppb	Part(s) Per Billion (µg/kg or µg/L)
ppm	Part(s) Per Million (mg/Kg or mg/L)
ppt	Part(s) Per Thousand (g/kg or g/L)
QA	Quality Assurance
QC	Quality Control
RL	Reporting Limit
ROD	Record of Decision
SOP	Standard Operating Procedure
µg/L	Microgram(s) Per Liter (ppb)

μm            Micrometer(s)  
USACE        U.S. Army Corps of Engineers  
USEPA        U.S. Environmental Protection Agency

## EXECUTIVE SUMMARY

The Vineland Chemical site is a 54-acre manufacturing facility located in Cumberland County, New Jersey (NJ) (Figure ES-1). The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles that resulted in soil and groundwater contamination in the vicinity of the site. Runoff during storm events and the recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including soil, sediment, and surface waters of nearby waterways such as Blackwater Branch, Maurice River, and Union Lake (Figure ES-1). Four long-term, remedial phases at the site focus on source control, migration management, and cleanup of the rivers and Union Lake sediments, which was the subject of a Record of Decision (ROD) in 1989 (USEPA 1989). Two general areas of consideration for the study include public health and remedial actions. The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain east of Mill Road and adjacent to the site. This excavation has the potential to stir up sediments and impact the waterways downstream. A monitoring program has been initiated that includes baseline (pre-excavation) sampling, during excavation/construction sampling, and post-construction sampling to determine the status of exposure and impacts to human health exposure pathways. The first survey, the May 2006 Baseline Sampling, was conducted prior to the initiation of planned remedial excavation activities in the Blackwater Branch (EA 2006a). The second survey, the November 2006 Periodic Sampling, was conducted during excavation activities at the site. The third survey, the September 2007 Post Remedial Action Sampling, was conducted following the completion of excavation for remedial action activities. The fourth survey, Periodic Sampling – Spring 2009, was completed in May 2009; at that time remediation activity was occurring on the west side of Mill Road. The fifth survey, Periodic Sampling – Fall 2009, was conducted in November 2009; remediation activity was being completed on the west side of Mill Road and at the Route 55 area.

This report presents the results of the fifth survey, Fall 2009 Periodic Sampling, that was conducted in November 2009. The Periodic Sampling was designed to identify, analyze, and evaluate the arsenic concentrations in sediments, soil, and water collected at ten locations in and near waterways located adjacent to the site following the Blackwater Branch excavation activities. EA Engineering, Science, and Technology, Inc. (EA) was contracted by the U.S. Army Corps of Engineers (USACE) - Philadelphia District to conduct sediment, soil, and surface water sampling at ten locations along Blackwater Branch, the Maurice River, and Union Lake. The arsenic concentration in each of the samples was measured by the U.S. Environmental Protection Agency (USEPA) Region II Laboratory located in Edison, New Jersey. The *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP) for Vineland Chemical Superfund Site* (USACE 2009) described the sampling and data-gathering methods for the project and followed guidance provided by the USACE Engineer Manual (EM) 200-1-3 *Requirements for Preparation of Sampling and Analysis Plans* (1994).

The following types of samples were collected and analyzed for arsenic during the Periodic Sampling - Fall 2009:

- Surficial sediment samples (0-0.5 ft depth increment beneath the water/sediment interface) co-located with the surface water samples collected at either midstream (for the river reaches) or at greater than 200 ft from the shoreline (for the lake stations);
- Surficial sediment nearshore (shore) samples (0-0.5 ft depth increment beneath the water/sediment interface) collected 2-10 ft below the waterline;
- Surface water collected prior to sediment collection or disturbance at each site;
- Surface water collected following agitation of sediment upstream from each sampling point; and
- Beach soils collected approximately 6-10 ft above the waterline.

Detected arsenic concentrations in water samples were compared to the USEPA Drinking Water Criterion for arsenic of 10 parts per billion (ppb or  $\mu\text{g/L}$ ), and the results for detected arsenic concentrations in sediment and soil were compared to the Site Clean-up Level of 20 parts per million (ppm or  $\text{mg/Kg}$ ) for arsenic in solids. The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic. The water, soil, and sediment results for each station from the Periodic Sampling – Fall 2009 were also compared to the May 2006 Baseline Sampling results (EA 2006a), November 2006 Periodic Sampling results (EA 2007), September 2007 Post Remedial Action Sampling results (EA 2008), and Periodic Sampling – Spring 2009 results. Additionally, the water, soil, and sediment results from the Periodic Sampling – Fall 2009 beach stations were compared to historical arsenic data collected from five beach stations during the year 1992 and from 1994 through 1999.

## ES.1 ARSENIC RESULTS

Figure ES-2 presents arsenic concentrations for each of the five sampling events: the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, and the Periodic Sampling – Fall 2009.

Overall, results of the Periodic Sampling – Fall 2009 indicated that arsenic concentrations in agitated water samples exceeded the 10  $\mu\text{g/L}$  criterion at four of the eight sampling locations. The last sampling event, Periodic Sampling – Spring 2009, had exceedences in agitated water samples at three of nine locations. The highest concentration of arsenic in an agitated water sample for Fall 2009 was at Station 9 (Union Lake Beach) with a value of 1,100  $\mu\text{g/L}$ .

As indicated in the May 2006 and November 2006 Sampling events, the two stations located immediately downstream of the Vineland site, Station 1 (West of Mill Rd.) and Station 2 (West of Rte. 55) had the highest concentrations of arsenic in sediment and had the greatest number of concentrations that exceeded the Site Clean-up Level of 20  $\text{mg/kg}$  for arsenic (Figure 3-1). Station 1 (West of Mill Road) was not sampled during the Periodic Sampling – Spring 2009 and Periodic Sampling – Fall 2009 events due to excavation and remediation at that location by the United States Corps of Engineers-Philadelphia District (USACE-Philadelphia). The Blackwater Branch's stream flow was also diverted at this location to allow excavation activities to be completed. Station 2 (West of Route 55), located immediately downstream of the Vineland site, had the highest concentrations of arsenic in sediment for the Spring 2009 sampling and also had the greatest number of concentrations exceeding the Site Clean-up Level of 20 ppm for arsenic

(Figure 3-1). Station 2 was not sampled during Periodic Sampling – Fall 2009 due to excavation and remediation at the site; the Blackwater Branch was also diverted at this location.

Two stations located downstream from Station 2 and upstream of Union Lake had arsenic concentrations in sediments and soils that exceeded the Site Clean-up Level of 20 mg/kg. Station 3 (Blackwater Branch confluence) had a concentration of 21 mg/Kg in the shore sediment and Station 6 (“BareA” Beach) had a concentration of 280 mg/Kg in the shore sediment.

The stations located along Union Lake had arsenic concentrations in sediments that exceeded the Site Clean-up Level of 20 ppm. The shore sample at Station 8 (North Union Lake) had a value of 65 mg/Kg. The sediment samples at Station 9 (Union Lake Beach) and Station 10 (South Union Lake) had concentrations of 330 mg/Kg and 40 mg/Kg, respectively. These trends in Union Lake may be attributable to the proportion of fine silt/clays in the sediment samples; arsenic is strongly sorbed onto fine particulates, including silt (Bodek et. al 1988). The arsenic that originates from upstream sources may be transported downstream via particulates which settle out in the lake depositional areas. Previous reports for the site have stated that sediment in the Maurice River and Union Lake contains a high content of organic matter (USEPA 1999). Arsenic concentrations from the five beach locations [Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 (“BareA” Beach), Station 9 (Union Lake Beach), and Station 10 (South End Union Lake Beach)] were either  $\leq 0.91$  mg/Kg or below the analytical detection limit.

Below Station 2 (West of Rte. 55), additional water flow from the Maurice River and other tributaries flowing into the Maurice River may transport arsenic that is bound to fine particulates further downstream. Previously in the May 2006 and November 2006 sampling events, arsenic concentrations in sediments, water, and beach soil did not exceed criteria at Station 4 (Alliance Beach), Station 5 (Almond Beach), or Station 6 (“BareA” Beach). In September 2007, the first exceedence of applicable criteria occurred at Station 5 (Almond Beach) in the agitated water sample and at Station 6 (“BareA” Beach) in both a surface water sample and a nearshore (shore) sediment sample. During sampling in May 2009 the only samples to exceed the Site Clean-up Levels were the agitated water sample (Wat2) and the shore (sediment) samples at Station 6; the arsenic concentrations were 65 ug/L and 21 mg/kg, respectively. Periodic Sampling – Fall 2009 had criteria exceedences of agitated water at Station 7 (Sherman Avenue) and shore samples at Station 3 (Blackwater Branch confluence) and Station 6 (“BareA” Beach).

Arsenic results for each sampling location and matrix (sediment, water, beach soil) are presented in Figure ES-2 and summarized as follows:

Station 1 – West of Mill Rd (see Figure 3-1)

Station 1 was not sampled during the Fall 2009 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 2 – West of Rte 55 (see Figure 3-1)

Station 2 was not sampled during the Fall 2009 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.



Station 3 – BWB & Maurice Confluence (see Figures 3-1 and 3-2)

Arsenic was detected above the Site Clean-up Level of 20 ppm in the nearshore (shore) sediment sample; a concentration of 21 mg/Kg was detected. None of the other samples exceeded criteria at this location.

Station 4 – Alliance Beach (see Figures 3-1 and 3-2)

Arsenic was not detected in the water, shore, or beach samples. Arsenic was detected in the surficial mid-stream sediment sample below the Site Clean-up Level of 20 ppm at a concentration of 0.79 mg/Kg.

Station 5 – Almond Beach (see Figures 3-1 and 3-3)

Arsenic was not detected in the water, shore, or beach samples. Arsenic was detected in the surficial mid-stream sediment sample below the Site Clean-up Level of 20 ppm at a concentration of 0.94 mg/Kg.

Station 6 – “BareA” Beach (see Figures 3-1 and 3-4)

Arsenic was not detected in the water, mid-stream, or beach samples. Arsenic was detected in the shore sediment sample at 280 mg/Kg which exceeded the Site Clean-up Level of 20 ppm by a factor of 14.

Station 7 – Sherman Ave. (see Figures 3-1 and 3-5)

The arsenic concentration in the agitated water sample was detected at 20 µg/L; the USEPA Drinking Water Criterion for water is 10 µg/L. Arsenic was also detected in the sediment sample at 1.8 mg/Kg and in the shore sample at 1.5 mg/Kg; both samples were below the Site Clean-up Level of 20 ppm.

Station 8 – North End of Union Lake (see Figures 3-1 and 3-6)

The arsenic concentration in the shore sediment sample exceeded the Site Clean-up Level of 20 ppm; the concentration of 65 mg/Kg exceeded the Site Clean-up Level by a factor of 3.25. Arsenic was detected in the sediment sample at 14 mg/Kg. The agitated water sample had an arsenic concentration of 230 µg/L which exceeded the USEPA Drinking Water Criteria of 10 µg/L by a factor of 23.

Station 9 – Union Lake Beach (see Figures 3-1 and 3-7)

Arsenic was detected in both the pre-agitated and agitated water samples. The pre-agitated water sample had a concentration of 10 µg/L; the agitated water sample had a concentration of 1100 µg/L, a factor of 110 above the Drinking Water Criteria of 10 µg/L. The sediment sample had an arsenic concentration of 330 mg/Kg which exceeded the Site Clean-up Level by a factor of 16.5. Arsenic was also detected at levels below the Site Clean-up Level of 20 ppm in the shore and beach samples. The shore sample had a concentration of 5.2 mg/Kg and the beach sample had a concentration of 0.91 mg/Kg.

Station 10 – South End of Union Lake Beach (see Figures 3-1 and 3-7)

Arsenic was detected in the agitated water sample at a concentration of 19 µg/L; this exceeded the Drinking Water Criteria by a factor of 1.9. The sediment sample had an arsenic

concentration of 40 mg/Kg which exceeded the Site Clean-up Level by a factor of 2. Arsenic was also detected in the shore sample at a concentration of 1 mg/Kg. Arsenic was not detected in the beach sample at this location.

## **ES.2 COMPARISONS TO HISTORICAL ARSENIC DATA**

During 1992 and from 1994 through 1999, water, soil, and sediment samples were collected in the vicinity of and downstream of the Vineland site at beach stations for arsenic analyses (USEPA/ERTC 1999). Data were collected from five beach locations including Alliance Beach (Station 4), Almond Beach (Station 5), "BareA" Beach (Station 6), Union Lake Beach (Station 9), and South End Union Lake Beach (Station 10). These data were compared to the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009 (May 2009), and the Periodic Sampling – Fall 2009 (November 2009) for surface water, beach soils, and surficial sediment arsenic concentrations.

### **Surface Water Data**

Throughout the period of 1992 and 1994-1999, arsenic concentrations in surface waters at Station 4 (Alliance Beach), Station 5 (Almond Beach), and Station 6 ("BareA" Beach) were variable and substantially exceeded the current USEPA Drinking Water Criterion of 10 ppb. Arsenic concentrations in surface waters at Station 9 (Union Lake Beach) slightly declined from 1996 (above criterion) through 1999 (below criterion). The arsenic concentration in surface water at Station 10 (South End of Union Lake Beach) was above the criterion in both 1998 and 1999. Surface water data from samples collected in both May 2006 and November 2006 indicated that arsenic was not detected in the surface waters at each of these five previously sampled locations (Stations 4, 5, 6, 9, and 10), with the exception of Station 10 (South End of Union Lake Beach) in May 2006, when arsenic in the agitated water sample was equivalent to the USEPA Drinking Criterion. However, in September 2007, there were several exceedences of the arsenic criterion in surface water. The majority of these exceedences corresponded to agitated water samples. During the May 2009 sampling only two agitated samples exceeded the arsenic criterion. The exceedences were found at Station 6 and Station 10. November 2009 sampling resulted in two agitated water samples that exceeded the arsenic criterion; Station 9 had an arsenic concentration of 1,100 µg/L and Station 10 had a concentration of 19 µg/L. The November 2009 arsenic concentration of 1,100 µg/L at Station 9 was the highest concentration measured between 1992 and 2009.

### **Beach Soil Data**

None of the beach soil samples collected in 1992, 1994 through 1999, and 2006 exceeded the Site Clean-up Level of 20 ppm for arsenic at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake Beach). Detected concentrations in May 2006, November 2006, September 2007, May 2009, and November 2009 were either comparable to or lower than those previously reported for each of the five stations. None of the 2006, 2007, and 2009 samples exceeded the Site Clean-up Level of 20 ppm.

### **Surface Sediment Data**

Throughout the period of 1992 and 1994-1999, arsenic concentrations were below the Site Clean-up Level of 20 ppm at each of the five stations, with the exception of Station 6 ("BareA" Beach) in 1998. Results from samples collected between May 2006 and November 2009 indicated that arsenic concentrations in surficial sediment (collected greater than 200 ft from the shoreline) at Station 9 (Union Lake Beach) and Station 10 (South End of Union Lake Beach) were substantially higher than concentrations previously reported in 1992 and 1994-1999. The data from May 2006 to May 2009 show a slight decrease in arsenic concentrations for each successive sampling event. Results from November 2009 indicate an increase in the arsenic concentration at Station 9 and Station 10 compared to May 2009 results.

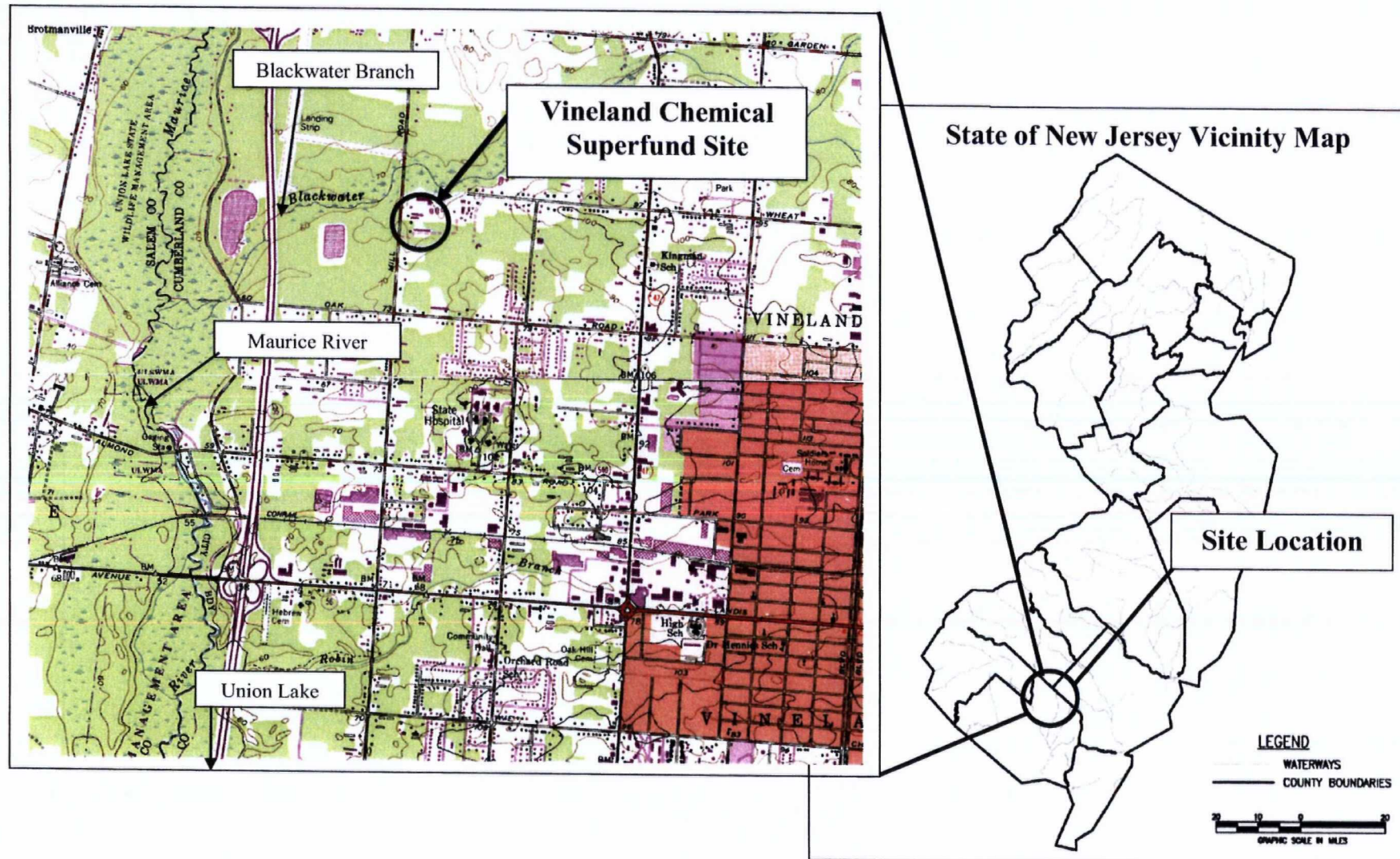


Figure ES-1. Vineland Chemical Superfund Site Location Map, Cumberland County, NJ

## 1. INTRODUCTION

This report presents results from an arsenic survey in the vicinity of Vineland Chemical Company Superfund Site in Cumberland County, New Jersey (NJ) that was conducted for 8 locations from 18 through 19 November 2009 in accordance with the *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP) for Vineland Chemical Superfund Site* (USACE 2009). These data will be used to document the arsenic concentrations in nearby waterways that have been impacted by previous operations of the site following the remediation activities. Results for soils and sediments will be compared to the Site Clean-up Level of 20 parts per million (ppm or mg/Kg) and results for surface water will be compared to the U.S. Environmental Protection Agency (USEPA) Drinking Water Criterion of 10 parts per billion (ppb or µg/L) for the protection of human health. These data (referred to as the Periodic Sampling – Fall 2009) represent the fifth sampling and monitoring event that was planned to assess the potential impacts of remedial activities at the site.

### 1.1 PROJECT BACKGROUND

Previous studies have shown that the Vineland Chemical Company Superfund Site (site) has arsenic contamination in the soils, sediments, and ground water. The site manufactured arsenic-based herbicides from 1950 to 1994 on a 54-acre site in a residential and industrial area of the City of Vineland, NJ. The site is located adjacent and upstream from nearby waterways that include the Blackwater Branch, Maurice River, and Union Lake (Figure 1-1). The soil, sediment, and water of these waterbodies have been impacted by the operations of the site. Beginning in 1982, and in response to State actions, the Vineland Chemical Company instituted some cleanup actions and modified the production process. The site clean-up is being addressed in two stages, including immediate actions and long-term remedial phases. Four long-term, remedial phases will focus on source control, migration management, and cleanup of the rivers and Union Lake sediments, which was the subject of a Record of Decision (ROD) in 1989 (USEPA 1989). The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain west of Mill Road to west of the Maurice River Parkway. This excavation has the potential to stir up sediments and impact the waterways downstream. Therefore, baseline (pre-excavation), during excavation, and post-remedial action sampling/monitoring is required.

Two general areas of consideration for the study include public health and remedial actions. The monitoring and sampling program is being completed to determine the status of exposure and impacts to human health exposure pathways. Results from sampling efforts will determine the extent of contamination in the surrounding areas prior to excavation activities, during excavation, and post-excavation. The first survey, the May 2006 Baseline Sampling (EA 2006a), was conducted prior to the initiation of planned remedial excavation activities in the Blackwater Branch. The second survey, the November 2006 Periodic Sampling (EA 2007), was conducted during excavation activities at the site. The third survey, the September 2007 Post Remedial Action Sampling, was conducted following the completion of excavation for remedial action activities east of Mill Road and adjacent to the site. The fourth survey, the Periodic Sampling – Spring 2009, was also conducted during excavation for remedial action activities west of Mill



Road to Route 55. The fifth survey, Periodic Sampling – Fall 2009, was conducted during excavation for remedial action activities west of Mill Road to west of the Maurice River Parkway.

A three year period of monitoring and sampling will be implemented at the completion of Operational Unit #1 remediation activities. This will determine the impacts of ongoing remedial activities including removal of contaminated soil and sediments and pump and treat groundwater program to facilitate evaluation of further remedial action in the river areas and Union Lake.

## **1.2 PROJECT LOCATION**

The Vineland Chemical site is a 54-acre manufacturing facility located in Vineland, Cumberland County, NJ (Figure 1-1). The site is located in south-central NJ, approximately 40 miles from Wilmington, Delaware and approximately 35 miles from Atlantic City, NJ. The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles. This resulted in soil and groundwater contamination in the vicinity of the site. Runoff during storm events and the recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including nearby waterways such as Blackwater Branch, Maurice River, and Union Lake.

## **1.3 PROJECT PURPOSE AND OBJECTIVES**

Determination of arsenic concentrations in the sediments, soil, and water in the vicinity of the site is necessary in order to provide information about the environmental conditions at the site during and following the Blackwater Branch excavation activities to assess potential human exposure to arsenic and to document the extent of contamination. This sampling and monitoring effort, the Periodic Sampling – Fall 2009, documents the levels of arsenic concentrations in the sediment, soil, and water during the excavation process, and compares current (November 2009) arsenic concentrations to the May 2006 Baseline Sampling (EA 2006a), the November 2006 Periodic Sampling (EA 2007), the September 2007 Post Remedial Action Sampling (EA 2008), the Periodic Sampling – Spring 2009 (EA 2009) and the historic (1992 and 1994 through 1999) arsenic concentrations at the site. The Periodic Sampling – Fall 2009 program consisted of the following tasks:

- Sediment, soil, and water sample collection at 8 locations;
- Analytical testing of sediment, soil, and water samples for arsenic concentrations;
- Data report preparation and submittal.

## **1.4 EXPERIMENTAL DESIGN**

The executing agency for this project is the U.S. Army Corps of Engineers (USACE), North Atlantic Division, Philadelphia District. This investigation was designed to identify, analyze, and evaluate the arsenic concentrations in sediments, soil, and water collected at nine locations in and near waterways located adjacent to the site. Previous sampling activities documented

arsenic concentrations at 10 locations, but two locations that were previously sampled (West of Mill Road and West of Route 55) were not sampled in the Fall 2009 because the stream areas where these stations were previously located were realigned/re-routed as part of the ongoing remedial activity. EA Engineering, Science, and Technology, Inc. (EA) was contracted by the USACE - Philadelphia District to conduct sediment, soil, and surface water sampling at ten locations along Blackwater Branch, the Maurice River, and Union Lake. Arsenic concentrations in each of the samples were measured by the USEPA Region II Laboratory located in Edison, NJ. The *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP)* (USACE 2009) described the sampling and data-gathering methods for the project and followed guidance provided by the USACE Engineer Manual (EM) 200-1-3 *Requirements for Preparation of Sampling and Analysis Plans* (1994).

## **1.5 REPORT ORGANIZATION**

This report contains a comprehensive summary of field activities and the results of the sediment, soil and water analyses. Field sampling techniques and analytical methodologies for arsenic analyses are provided in Chapter 2 and results of the arsenic analyses are provided in Chapter 3. A summary of findings and a comparison to historical data is provided in Chapter 4. References cited are provided in Chapter 5. Appendix A presents the analytical results and accompanying Chain-of-Custody (COC) forms from the arsenic analyses; Appendix B provides a copy of the field logbook; Appendix C presents the Standard Operating Procedures (SOPs) for the laboratory analysis of arsenic; and Appendix D presents the historical arsenic data results from the years 1992 and from 1994 through 1999.

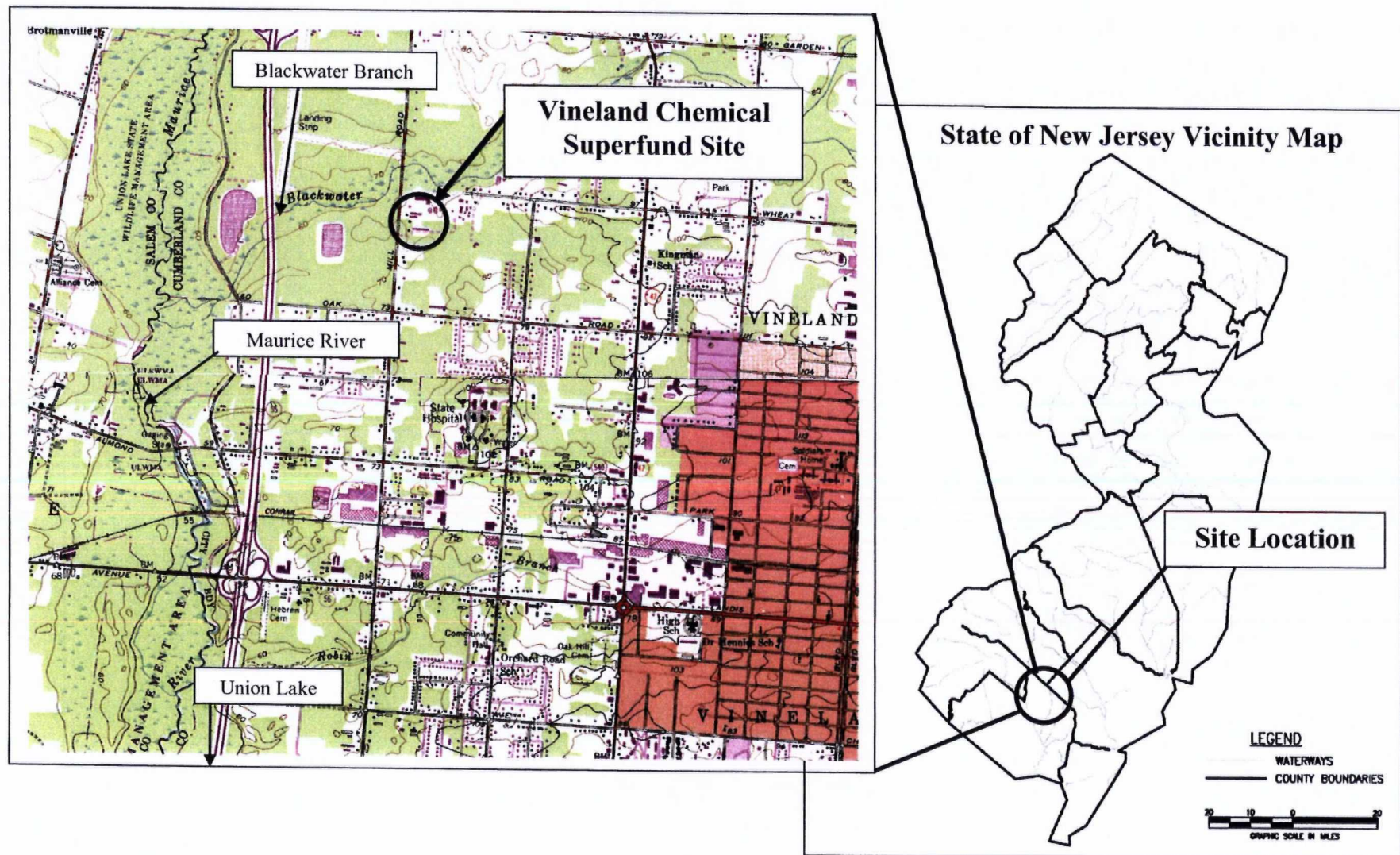


Figure 1-1. Vineland Chemical Superfund Site Location Map, Cumberland County, NJ



## 2. METHODOLOGY

This Periodic Sampling – Fall 2009 event was carried out in accordance with the *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP)* (USACE 2009). Collection of the water, soil, and sediment quality samples was completed on 18 and 19 November 2009.

Table 2-1 summarizes the sampling requirements for the project. Two water samples (the first representing a sample without bottom disturbance and the second representing a sample following agitation/disturbance of the bottom sediments) were collected from each of eight stations (16 total water samples). In addition, one surficial sediment sample was collected from mid-stream (or 200 ft from offshore at lake locations) at each of eight stations, one nearshore (shore) sediment sample was collected from each of eight stations, and one beach soil sample was collected from each of five stations. Each sediment, soil, and water sample was analyzed for total arsenic concentrations. Previous sampling efforts included sediment, soil, and water samples at two locations: West of Mill Road and West of Route 55. Due to remediation activities at these locations, the Blackwater Branch was re-aligned and sediment and soil material was excavated. No samples were taken at these locations for the Fall 2009 sampling effort.

### 2.1 SAMPLING OBJECTIVES

The sampling effort included surficial sediment sampling, surface water sampling, nearshore (shore) sediment sampling, and beach soil sampling. Table 2-1 provides the sampling locations and number of samples collected as part of the Fall 2009 sampling event for the project. Table 2-2 provides the sampling locations, coordinates of the sampling efforts, and sample identification. The overall objectives of the field sampling were to:

- Collect two surface water samples (mid-stream and mid-depth) of the water column (one prior to sediment disturbance and one following sediment disturbance) at each of 8 locations for arsenic analysis;
- Collect one shallow sediment sample (0-0.5 ft depth increment beneath the water/sediment interface) at 8 locations at either mid-stream (for upper sampling locations approx. 2-3 ft from shoreline) or greater than 200 ft from the shoreline (lake sampling locations) for arsenic analysis;
- Collect one shallow, nearshore (shore) sediment sample (0-0.5 ft depth increment beneath the water/sediment interface) at 8 locations approximately 2-10 ft below the waterline for arsenic analysis;
- Collect one beach soil sample at five locations approximately 6-10 ft above waterline for arsenic analysis;
- Collect and transfer sediment, soil, and water samples to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity;

- Measure and record *in situ* water quality information (temperature, conductivity, salinity, dissolved oxygen, and pH) at each surface water sampling location;
- Submit equipment blanks, duplicates, and matrix spike/matrix spike duplicates for analytical testing; and
- Complete appropriate COC documentation.

## 2.2 SAMPLING LOCATION DETERMINATION

Sampling locations were provided by USACE-Philadelphia District and correspond to locations that were sampled in previous investigations (USEPA/ERTC 1999, EA 2006a, EA 2007, EA 2008). Sampling locations and northing and easting coordinates [NJ State Plane North American Datum 1983 (NAD83)] are provided in Table 2-2. Positioning in the field was determined using a Trimble ProXR Differential Global Positioning System (DGPS), which utilizes the United States Coast Guard Differential Beacon System to obtain sub-meter accuracy. Sample locations and a brief description are included below:

### Sample Location:

### Description of Sampling Location:

1) West of Mill Rd	Along Blackwater Branch, immediately downstream of site; not sampled for Fall 2009 due to realignment of Blackwater Branch and excavation of soil and sediment.
2) West of Rte 55	Along Blackwater Branch, further downstream of site; not sampled for Fall 2009 due to realignment of Blackwater Branch and excavation of soil and sediment.
3) BWB & Maurice Confluence	At the Blackwater Branch and Maurice River confluence
4) Alliance Beach	Privately owned and located along the Maurice River and upstream of Almond Beach
5) Almond Beach	Along the Maurice River, publicly maintained beach area, approximately 100-150 ft long
6) "BareA" Beach	Along the Maurice River, downstream of Almond Beach, unmaintained public day-use area
7) Sherman Ave.	Along the Maurice River, at the Sherman Avenue Bridge
8) North End of Union Lake	In the northern section of Union Lake
9) Union Lake Beach	Privately maintained beach area, downstream of site (access at Union Lake Sailing and Tennis Club)
10) South End Union Lake Beach	In the southern section of Union Lake, north of the spillway

## **2.3 SAMPLE VOLUME REQUIREMENTS**

The sample volume requirements are detailed in Table 2-1 for arsenic analyses. Arsenic analysis of sediments and beach soils required 250 grams of sediment per sample. Water samples required 250 milliliters (ml) per sample for arsenic analysis. For arsenic analyses, a total (not including field duplicates, matrix spike, and matrix spike duplicates) of eight sediment samples, eight shore samples, and five beach soil samples were collected for the Periodic Sampling – Fall 2009 effort. For arsenic analyses, 16 water samples (not including field duplicates, equipment blanks, matrix spike, and matrix spike duplicates) were collected.

## **2.4 IN SITU WATER QUALITY MEASUREMENTS**

Water quality measurements were recorded *in situ* at each of the nine stations using a YSI water quality probe. Measurements were recorded at the same locations where water samples were collected for chemical analysis (mid-stream/mid-depth of the water column). The following parameters were recorded in the field log book:

- Sampling location number
- Sampling data and time
- Station depth
- Weather conditions
- Water temperature [degrees (°) Celsius]
- Conductivity (mS/cm)
- pH
- Dissolved oxygen [milligrams per liter (mg/L)]

A summary of the water quality data is provided in Table 2-3. Copies of the field logbook are provided in Appendix B.

## **2.5 SAMPLE COLLECTION, STORAGE, AND TRANSPORT**

Upon completion of sample collection, samples were shipped via overnight delivery to the USEPA Region II, Division of Environmental Science and Assessment (DESA) Laboratory in Edison, NJ for arsenic analyses. Samples were shipped on ice and maintained at 4° Celsius. COCs accompanied the samples and documented the dates and times of sample collections for arsenic analyses are included in Appendix A. Samples were received at the DESA laboratory on 20 November 2009 for arsenic analyses and the samples were booked and logged through the Field and Analytical Services Teaming Advisory Committee (FASTAC) process.

### **2.5.1 Surface Water Samples**

Surface water samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake for arsenic analysis. At each location, one surface water sample was collected as a mid-stream, mid-water column sample prior to any disturbance of bottom

sediment. The second surface water sample was collected at the same location as above after disturbance of the bottom sediment. This “disturbed” sample was used to simulate potential human exposure to arsenic contaminated surface water with suspended sediment during recreational contact (i.e., beach use, wading, and swimming).

The “disturbance” to the sediment was conducted by wading in the water in a region 0-10 ft upstream of the sampling location for approximately 30 seconds. The “disturbed” water sample was collected from mid-depth of the water column immediately following the disturbance of the bottom sediments.

Water samples were collected using an ISCO peristaltic pump with dedicated Tygon tubing. Water samples were transferred directly to pre-cleaned 250 ml plastic bottles preserved with nitric acid. Samples were kept on ice and maintained at 4<sup>0</sup> Celsius.

## **2.5.2 Shallow Sediment Samples**

Two types of shallow sediment samples were collected, including in-stream and nearshore (shore) sediment samples for arsenic analysis. The shallow sediment samples were collected using a decontaminated stainless-steel Ponar grab sampler. Samples were homogenized in the field using stainless steel bowls and spoons immediately following sample collection. The homogenized sediment samples were then transferred directly to 4 ounce glass jars; samples were kept on ice and maintained at 4<sup>0</sup> Celsius. The stainless steel bowls and spoons were decontaminated following the process described in Section 2.6.

### **2.5.2.1 In-Stream Sediment Samples**

In-stream sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake. Sediment samples were co-located with surface water samples. The shallow sediment samples were collected from the 0-0.5 ft depth increment beneath the water/sediment interface. These samples were collected at either midstream (river locations) or at a distance of greater than 200 ft from the shoreline (lake locations).

### **2.5.2.2 Nearshore (Shore) Sediment Samples**

Nearshore (shore) sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake 2-10 ft feet below the waterline. Similar to the shallow sediment sample collection, the shore sediment sample was collected from the 0-0.5 ft depth increment beneath the water/sediment interface and used to simulate potential human exposure to arsenic contaminated sediment during recreational activities/recreational contact (i.e., beach wading, playing in shallow near shore water, a special concern regarding children).

## **2.5.3 Beach Soils**

Beach soils were sampled from five locations along the Maurice River and Union Lake for arsenic analysis. Figure 2-1 provides the location of the beach sampling points. Sampling points

were located at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End Union Lake Beach).

Samples were collected at the closest shore area adjacent to sediment sampling locations and approximately 6-10 ft above the waterline using a stainless steel spoon/shovel. A grab surface soil sample from a depth of 0-0.5 ft was collected and transferred to a stainless steel bowl and homogenized with a stainless steel spoon. The homogenized sediment samples were then transferred directly to a 4 ounce glass jar; samples were kept on ice and maintained at 4<sup>0</sup> Celsius. The stainless steel shovel, bowls, and spoons were decontaminated following the process described in Section 2.6.

#### **2.5.4 Equipment Blanks**

Equipment blanks were collected to determine the extent of contamination, if any, from the sampling equipment used as part of the project. A total of five equipment blanks (Tables 2-1 and 2-4) were collected for the Periodic Sampling – Fall 2009 event, which included the following:

- One blank per sampling day (two samples collected) for shallow sediment sampling/beach sampling equipment (i.e., grab sampler and stainless steel bowls and spoons) and,
- One blank per sampling event/phase (one sample collected) for dedicated water collection equipment (i.e., water pump tubing).

Equipment blanks were collected by pouring deionized water, which is provided by EA's Ecotoxicology Laboratory, over sampling equipment that was decontaminated using the procedure outlined in Section 2.6. The rinsate water was placed in laboratory-prepared containers, submitted to the analytical laboratory, and tested for the same chemical parameters as the sediments and site water. Equipment blanks were sent with the surface water, sediment, and beach soil samples to the USEPA Region II DESA laboratory for arsenic analyses.

#### **2.5.5 Field Duplicates**

Field duplicate samples were collected simultaneously from the same sampling locations as sediment and water samples and are used as measures of matrix homogeneity and sampling precision (Table 2-4). Field duplicates were collected at a rate of 10% per sample matrix. A total of nine duplicate samples were collected as individual co-located samples, and they were homogenized separately. Seven field duplicate samples were collected at random locations for sediment and two field duplicate samples were collected at random locations for water.

#### **2.5.6 Matrix Spike / Matrix Spike Duplicate Samples**

A matrix spike (MS) is a field sample to which a known amount of analyte is added before sample preparation and analysis to evaluate the potential effects of matrix interference. Analyte concentrations in the spiked and unspiked sample are used to calculate percent recovery as a measure of matrix interference. A matrix spike duplicate (MSD) is a duplicate of the MS sample. MS/MSD samples were collected at a rate of 10% per sample matrix. Additional

volumes of sediment and water were collected at random locations and included two sets of MS/MSD for sediment and soil samples and one set of MS/MSD for water samples (Table 2-4).

## **2.6 EQUIPMENT DECONTAMINATION PROCEDURES**

Equipment that came into direct contact with sediment and beach soil during sampling was decontaminated prior to deployment in the field to minimize cross-contamination. This included the stainless-steel Ponar, stainless steel spoons, and processing equipment (spoons, knives, bowls, extruder, etc.). While performing the decontamination procedure, phthalate-free nitrile gloves were used to prevent phthalate contamination of the sampling equipment or the samples.

The decontamination procedure is described below:

- Rinse equipment using clean tap or site water
- Wash and scrub with non-phosphate detergent (Alconox or other laboratory-grade detergent)
- Rinse with tap water
- Rinse with 1 percent nitric acid ( $\text{HNO}_3$ )
- Rinse with distilled or de-ionized water
- Rinse with methanol followed by hexane
- Rinse with distilled or de-ionized water

Waste liquids were contained during decontamination procedures and transferred to EA's facility in Sparks, Maryland, for disposal.

## **2.7 SAMPLE CHAIN-OF-CUSTODY AND DOCUMENTATION**

### **2.7.1 Field Logbook**

Field notes were recorded in a permanently bound, dedicated field logbook. A log of sampling activities and station locations were recorded in the log in indelible ink. Personnel names, local weather conditions, and other applicable field sampling program information were also recorded.

Sample location coordinates, approximate water depth, and weather conditions at each sampling location were recorded. In addition, water quality was measured and recorded at each station using an electronic water quality monitoring instrument. Information was recorded in indelible ink. Copies of the project logbook are provided in Appendix B.

## 2.7.2 Sample Identification

A sample numbering system was utilized for the sediment, soil, and water samples. The sample numbering system provided communication between the sample processing operation and the laboratory performing the desired analyses. Surface water, shallow sediment, and beach soil samples were identified by site name, sample type, and date of collection. See table below for sample identification by locations:

<u>Sample Location:</u>	<u>Sample Identification:</u>
3) BWB & Maurice Confluence	BWB-
4) Alliance Beach	Alliance-
5) Almond Beach	Almond-
6) "BareA" Beach	BA-
7) Sherman Ave.	Sherman-
8) North End of Union Lake	NUL-
9) Union Lake Beach	ULB-
10) South End Union Lake Beach	SUL-

The following sample descriptors were then used to denote sample types:

- Shore – shallow sediment collected within 2-10 ft below the waterline;
- Sed – shallow sediment co-located with the surface water sample;
- Wat1 – surface water sample collected prior to sediment and/or core collection;
- Wat2 – surface water sample collected after sediment and/or core collection (following agitation and disturbance of the sediments);
- Beach – beach soil collected at the closest area adjacent to sediment sampling locations (approximately 6-10 ft above the waterline).

For example, sample BWB-Shore-*date* (MMDDYY) indicated a shallow sediment sample collected within 2 feet of the shoreline at the station located at the confluence of the Blackwater Branch and Maurice River. Each sample name was then followed with a date consisting of day, month, and year of sample collection to enable differentiation between future sampling and monitoring events that will be scheduled at the site as part of the remediation activities.

Field Duplicate water and sediment samples were submitted to the laboratory as blind duplicates. The site name and collection date were not designated as part of the sample identifier. Duplicate samples were designated with an identifier (i.e., DUP) and number (i.e., 1, 2, 3, etc.). For example, DUP-1 was designated as the first duplicate sample collected from a random station. DUP-2 was then designated as the next (or second) duplicate sample collected from a separate random station. Locations where duplicate samples were collected and the corresponding sample ID were recorded in the field logbook for future cross-referencing with sample laboratory results. The cross-referenced sampling locations for the field duplicates are included in Table 2-4.

MS/MSD sediment, soil, and water samples were designated with identifiers added after the site name and sample type. For example, BA-Beach-MS-*date* indicated a matrix spike beach soil

sample from the station located at “BA” Beach. The following descriptors were used for matrix spike and matrix spike duplicate samples:

- MS – matrix spike sample
- MSD – matrix spike duplicate

Equipment blanks were identified by type of blank, number of each type, and date (Table 2-4). For example, PBlank-02-date represented the second rinsate blank for the Ponar grab sampler and bowls and spoons used for shallow sediment sampling. The following descriptors were used to denote equipment blanks:

- PBlank – Ponar grab sampler and bowls/spoons for shallow sediment samples
- BSBBlank – Bowls and spoons used for beach sampling
- TTBlank – dedicated tygon tubing blank for water sampling

### **2.7.3 Sample Documentation**

#### **2.7.3.1 Sample Labels**

Both the individual sediment cores and the processed sediment were labeled. Sample containers for the processed sediment and water samples were labeled with the following information:

- Client name
- Project number
- Sample ID
- Station location
- Date and time of collection
- Sampler’s initials
- Type of analyses required

#### **2.7.3.2 Chain-of-Custody Records**

Sediment, soil, and water samples collected in the field and at EA’s processing facility were documented on a COC form. This COC accompanied the samples to the analytical and geotechnical laboratories. The COC indicated the date and time of sample collection and was signed by appropriate personnel. Copies of the COCs that accompanied the analytical testing for arsenic are provided in Appendix A.

### **2.7.4 Documentation Procedures**

Documentation was initialed by the author and dated. Corrections to documentation were made with a single line through the error with the author’s initials and date.



## 2.8 ANALYTICAL METHODS

Analytical testing for arsenic was conducted by the USEPA Region II DESA Laboratory Branch located in Edison, NJ.

### 2.8.1 Analytical Methods, Laboratory Quality Control, and Detection Limits

Samples obtained during the Periodic Sampling – Fall 2009 were analyzed for total arsenic using extraction procedure DESA SOP C-116 and analysis procedure DESA SOP C-109. Table 2-1 summarizes analytical information (total number of samples, QA/QC samples, sample volumes, sample holding times, and preservatives) for the project. The target detection limits (TDL)/screening values and laboratory reporting limits (RL) for arsenic in the water and soils were as follows:

Matrix	Target Detection Limit (TDL) / Screening Value for Arsenic	Laboratory Reporting Limit (RL) for Arsenic	Extraction/Analysis Procedure
Water	10 ppb (USEPA Drinking Water Criterion)	8 µg/L (ppb)	DESA SOP C-116 and SOP C-109
Solid	20 ppm (Site Clean-up Level)*	0.73 to 0.8 mg/Kg (ppm)	DESA SOP C-116 and SOP C-109

*\*The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic.*

Copies of the USEPA Region II DESA Laboratory Branch SOPs for sample digestion and for analysis of metals are provided in Appendix C, as well as laboratory Quality Control (QC) and Quality Assurance (QA) procedures.

### 2.8.2 Data Validation and Electronic Data Deliverables

Data validation was conducted by the USEPA Region II DESA laboratory for the arsenic analyses. A data quality and usability statement was not provided by DESA for the analytical results. Data are usable for the intended purpose except where noted by the USEPA data validation qualifiers.

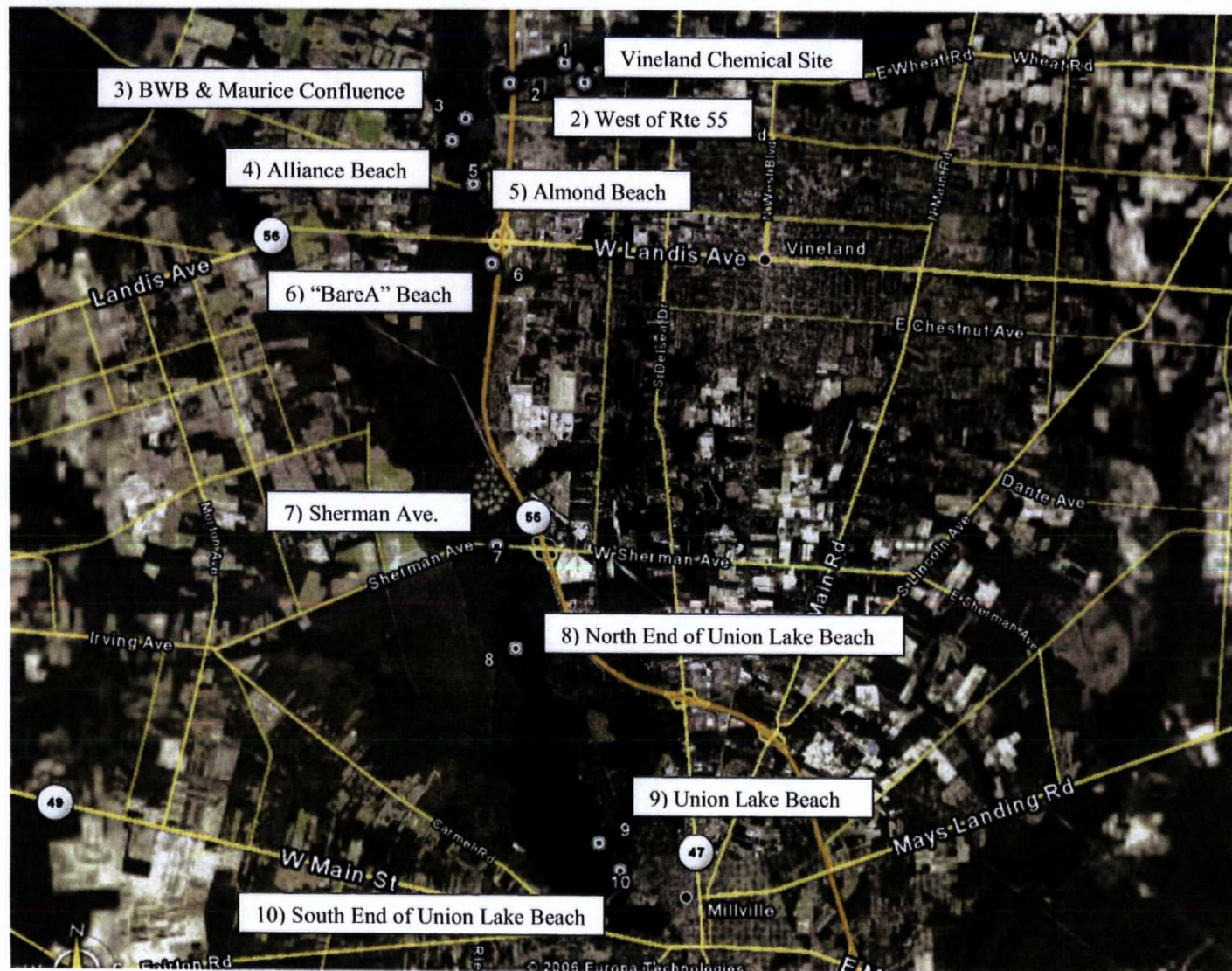


Figure 2-1. Sampling Locations in Vicinity of Vineland Chemical Superfund Site, November 2009

**TABLE 2-1. SUMMARY OF SEDIMENT, SOIL, AND WATER SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, NOVEMBER 2009**  
**VINELAND PERIODIC SAMPLING - FALL 2009**

Sample Location (Name)	Sample Date	Type and Number of Samples			
		Sediment (sed)	Water (wat1/wat2)	Beach (beach)	Shore (shore)
		Arsenic	Arsenic	Arsenic	Arsenic
1) West of Mill Rd (MILL)	Not sampled	0	0	-	0
2) West of Rte 55 (R55)	Not sampled	0	0	-	0
3) BWB & Maurice Confluence (BWB)	11/18/2009	1 + DUP	2 + MS, MSD	-	1 + DUP
4) Alliance Beach (ALLIANCE)	11/18/2009	1	2	1 + DUP	1
5) Almond Beach (ALMOND)	11/18/2009	1	2	1	1 + DUP
6) "BareA" Beach (BA)	11/18/2009	1	2	1 + MS, MSD	1 + DUP
7) Sherman Ave. (SHERMAN)	11/18/2009	1 + DUP	2	-	1
8) North End of Union Lake (NUL)	11/19/2009	1	2 + DUP	-	1
9) Union Lake Beach (ULB)	11/19/2009	1	2 + DUP	1 + MS, MSD	1
10) South End Union Lake Beach (SUL)	11/19/2009	1	2	1 + DUP	1
NUMBER OF SAMPLES	-	8	16	5	8
NUMBER OF QC SAMPLES	-	2	4	6	3
TOTAL NUMBER OF SAMPLES	-	10	20	11	11
<b>Arsenic Samples:</b>		<b>Sediment</b>	<b>Water</b>	<b>Beach</b>	<b>Shore</b>
Sample Volume		1 x 250 g	1 x 250 ml	1 x 250 g	1 x 250 g
Holding Time		6 months	6 months	6 months	6 months
Preservative/Temperature		4°C	HNO <sub>3</sub> to pH <2, 4°C	4°C	4°C
Extraction/Analysis Methodologies		USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109

**NOTE:**

QC sample duplicates were collected and analyzed for each media at a rate of approximately 10% per sample matrix per analysis per sample event.

Sediment/soil equipment blanks= 1 blank each per day for beach soil and sediment

Aqueous equipment blank = 1 blank total for dedicated water pump/tubing

**Blank Equipment Samples (5) Collected for Arsenic:**

BSBLANK-01, 02: Bowls and spoons used for beach sampling

PBLANK-01, 02: Ponar grab sampler and bowls/spoons for shallow sediment samples

TTBLANK-01: Dedicated tygon tubing blank for water sampling

**TABLE 2-2. COORDINATES FOR WATER, SOIL, AND SEDIMENT SAMPLES  
COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE  
NOVEMBER 2009**

**VINELAND PERIODIC SAMPLING - FALL 2009**

<b>Sample Location</b>	<b>Sample Identification</b>	<b>Northing (ft)*</b>	<b>Easting (ft)*</b>
1) West of Mill Rd	No sampling at location in November 2009 due to remedial activity.		
2) West of Rte 55	No sampling at location in November 2009 due to remedial activity.		
3) BWB & Maurice Confluence	BWB-SED	244861.3	329115.3
	BWB-WAT1, 2	244861.3	329115.3
	BWB-SHORE	244869.7	329121.5
4) Alliance Beach	ALLIANCE-SED	243933.9	328591.8
	ALLIANCE-WAT1, 2	243933.9	328591.8
	ALLIANCE-SHORE	243944.7	328576.3
	ALLIANCE-BEACH	243958.3	328559.4
5) Almond Beach	ALMOND-SED	241839.9	329514.7
	ALMOND-WAT1, 2	241839.9	329514.7
	ALMOND-SHORE	241835.2	329541.1
	ALMOND-BEACH	241842.1	329555.6
6) "BareA" Beach	BA-SED	237991.9	330353.4
	BA-WAT1, 2	237991.9	330353.4
	BA-SHORE	237993.7	330364.3
	BA-BEACH	238011.7	330398.3
7) Sherman Ave.	SHERMAN-SED	224385.6	330557.8
	SHERMAN-WAT1, 2	224385.6	330557.8
	SHERMAN-SHORE	224383.2	330560.5
8) North End of Union Lake	NUL-SED	219602.9	331300.6
	NUL-WAT1, 2	219602.9	331300.6
	NUL-SHORE	219656.9	331330.7
9) Union Lake Beach	ULB-SED	210478.8	335138.0
	ULB-WAT1, 2	210478.8	335138.0
	ULB-BEACH	210342.0	335386.4
	ULB-SHORE	210331.3	335338.3
10) South End Union Lake Beach	SUL-SED	208736.0	336364.9
	SUL-WAT1, 2	208736.0	336364.9
	SUL-SHORE	208756.0	336536.7
	SUL-BEACH	208757.3	336558.2

\*Coordinates are in New Jersey State Plane (ft), NAD 83

**TABLE 2-3. *IN SITU* WATER QUALITY MEASUREMENTS COLLECTED IN VICINITY OF VINELAND  
CHEMICAL SUPERFUND SITE, NOVEMBER 2009, MAY 2009, SEPTEMBER 2007, NOVEMBER 2006, MAY 2006,  
AND MAY 1999\***

**VINELAND PERIODIC SAMPLING - FALL 2009**

Sample Location	Date and Time of Sample	Sample Depth	Water Temperature (degrees C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm)
3) BWB & Maurice Confluence	11/18/09 1320	Surface	10.1	0.11	10.5	7.5	0.171
4) Alliance Beach	11/18/09 1401	Surface	10.3	0.12	10.7	7.5	0.175
5) Almond Beach	11/18/09 1515	Surface	10.4	0.11	10.6	7.1	0.171
6) "BareA" Beach	11/18/09 1613	Surface	10.5	0.11	10.8	7.0	0.170
7) Sherman Ave.	11/18/09 1702	Surface	11.2	0.13	10.6	7.2	0.197
8) North End of Union Lake	11/19/09 0834	Surface	11.1	0.12	10.3	7.6	0.190
9) Union Lake Beach	11/19/09 0918	Surface	11.1	0.12	10.9	7.5	0.179
10) South End of Union Lake Beach	11/19/09 0955	Surface	11.1	0.12	10.9	7.4	0.179
2) West of Rte 55	5/18/09 1110	Surface	14.9	0.07	13.4	6.0	0.117
3) BWB & Maurice Confluence	5/18/09 1335	Surface	16.1	0.06	12.8	6.4	0.097
4) Alliance Beach	5/18/09 1241	Surface	16.0	0.06	13.9	6.3	0.096
5) Almond Beach	5/18/09 1459	Surface	16.7	0.06	8.6	6.3	0.097
6) "BareA" Beach	5/18/09 1603	Surface	16.9	0.06	12.6	6.4	0.098
7) Sherman Ave.	5/18/09 1653	Surface	17.3	0.07	7.3	6.4	0.124
8) North End of Union Lake	5/19/09 0857	Surface	14.0	0.08	11.5	6.4	0.122
9) Union Lake Beach	5/19/09 0940	Surface	18.5	0.06	7.6	6.9	0.112
10) South End of Union Lake Beach	5/19/09 1017	Surface	18.7	0.06	7.0	6.8	0.112
1) West of Mill Rd	9/10/07 1730	Surface	22.3	0.06	8.9	7.6	0.121
2) West of Rte 55	9/11/07 0943	Surface	18.8	0.09	8.5	8.0	0.195
3) BWB & Maurice Confluence	9/11/07 1200	Surface	22.7	0.06	7.4	7.7	0.138
4) Alliance Beach	9/11/07 1404	Surface	22.9	0.07	7.3	7.5	0.140
5) Almond Beach	9/11/07 1538	Surface	22.8	0.07	7.4	7.2	0.140
6) "BareA" Beach	9/10/2007 1420	Surface	23.8	0.07	8.1	7.8	0.150
7) Sherman Ave.	9/10/07 1530	Surface	22.7	0.09	7.4	7.2	0.193
8) North End of Union Lake	9/12/07 1121	Surface	20.3	0.08	7.3	7.7	0.176
9) Union Lake Beach	9/12/07 1214	Surface	25.2	0.07	7.0	7.6	0.159
10) South End of Union Lake Beach	9/12/2007 1447	Surface	25.3	0.07	7.2	7.6	0.160
1) West of Mill Rd	11/02/06 0855	Surface	12.9	0.04	5.4	6.7	0.073
2) West of Rte 55	11/02/06 0940	Surface	12.8	0.05	7.6	6.6	0.089
3) BWB & Maurice Confluence	11/02/06 1047	Surface	12.3	0.04	7.6	6.1	0.068
4) Alliance Beach	11/02/06 1144	Surface	12.5	0.04	7.9	6.2	0.069
5) Almond Beach	11/01/06 1655	Surface	13.0	0.04	5.5	6.0	0.070
6) "BareA" Beach	11/01/06 1600	Surface	12.9	0.04	5.6	6.3	0.071
7) Sherman Ave.	11/01/06 1443	Surface	13.1	0.06	5.8	7.0	0.106
8) North End of Union Lake	11/01/06 1140	Surface	12.3	0.06	6.0	6.7	0.092
9) Union Lake Beach	11/01/06 1230	Surface	11.3	0.06	6.4	7.7	0.087
10) South End of Union Lake Beach	11/01/06 1300	Surface	12.9	0.06	6.8	8.3	0.093
1) West of Mill Rd	5/23/06 0840*	Surface	12.7	0.08	9.8	7.1	0.137
2) West of Rte 55	5/23/06 1808*	Surface	17.4	0.08	10.2	6.9	0.145
3) BWB & Maurice Confluence	5/25/06 0849*	Surface	17	0.05	8.8	7.2	0.098
4) Alliance Beach	5/23/06 1340*	Surface	17	0.07	9.9	6.9	0.126
5) Almond Beach	5/23/06 1453*	Surface	17.6	0.07	10.3	6.9	0.123
6) "BareA" Beach	5/23/06 1535*	Surface	17.7	0.05	10.1	6.8	0.101
7) Sherman Ave.	5/23/06 1710*	Surface	17.7	0.08	9.5	7.1	0.148
8) North End of Union Lake	5/24/06 1157*	Surface	15.8	0.07	10	6.9	0.116
9) Union Lake Beach	5/24/06 1318*	Surface	19	0.06	10.1	7.3	0.117
10) South End of Union Lake Beach	5/24/06 1642*	Surface	20	0.06	10.5	7.7	0.111
4) Alliance Beach	5/1999**	unknown	15.1	0.0	8.9	6.3	0.079
5) Almond Beach	5/1999**	unknown	13.5	0.0	8.7	6.4	0.077
6) "BareA" Beach	5/1999**	unknown	14.6	0.0	9.7	5.8	0.079
9) Union Lake Beach	5/1999**	unknown	16.9	0.0	9.7	5.7	0.091
10) South End of Union Lake Beach	5/1999**	unknown	15.3	0.0	9.4	5.9	0.093

\*\*May 1999 data were referenced from (USEPA /ERTC 1999) citation

**TABLE 2-4. DUPLICATE, EQUIPMENT BLANK, AND MATRIX SPIKE SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, NOVEMBER 2009**

**VINELAND PERIODIC SAMPLING - FALL 2009**

Sample Location	Arsenic Station ID		Date Collected	Matrix
	Sample ID	Duplicate Cross-Referenced Station		
Field Duplicate	DUP-1	BWB-Sed	11/18/2009	Sediment
	DUP-2	Alliance-Beach	11/18/2009	Sediment
	DUP-3	BWB-Shore	11/18/2009	Sediment
	DUP-4	Almond-Shore	11/18/2009	Sediment
	DUP-5	BA-Shore	11/18/2009	Sediment
	DUP-6	Sherman-Sed	11/18/2009	Sediment
	DUP-7	NUL-Wat1	11/19/2009	Aqueous
	DUP-8	ULB-Wat2	11/19/2009	Aqueous
	DUP-9	SUL-Beach	11/19/2009	Sediment
Equipment Blank	PBlank-01	N/A	11/18/2009	Aqueous
	PBlank-02	N/A	11/19/2009	Aqueous
	BSBlank-01	N/A	11/18/2009	Aqueous
	BSBlank-02	N/A	11/19/2009	Aqueous
	TTBlank-01	N/A	11/19/2009	Aqueous
Matrix Spikes (MS) and Matrix Spike Duplicates (MSD)	BWB-Wat2-MS	N/A	11/18/2009	Aqueous
	BWB-Wat2-MSD	N/A	11/18/2009	Aqueous
	BA-Beach-MS	N/A	11/18/2009	Sediment
	BA-Beach-MSD	N/A	11/18/2009	Sediment
	ULB-Beach-MS	N/A	11/19/2009	Sediment
	ULB-Beach-MSD	N/A	11/19/2009	Sediment

### 3. RESULTS

The Periodic Sampling – Fall 2009 results for each station and sampling matrix are presented in Figure 3-1. Arsenic results by individual station locations are presented in Figures 3-2 through 3-7. Detected arsenic concentrations in water samples were compared to the USEPA Drinking Water Criterion for arsenic of 10 parts per billion (ppb or  $\mu\text{g/L}$ ), and the results for detected arsenic concentrations in sediment and soil were compared to the Site Clean-up Level of 20 parts per million (ppm or  $\text{mg/Kg}$ ). The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic. The laboratory report and the accompanying COC forms are provided in Appendix A. Appendix C provides the SOPs for the laboratory analyses.

#### 3.1 WATER

##### 3.1.1 *In Situ* Water Quality

Water quality measurements were recorded *in situ* at each of the eight locations where water samples were collected for chemical analysis (mid-stream/mid-depth of the water column) (Table 2-3). Table 2-3 also includes *in situ* water quality data collected during the May 2009 (EA 2009), September 2007 (EA 2008), November 2006 (EA 2007), May 2006 (EA 2006a), and May 1999 (USEPA/ERTC 1999) field collections at the site for comparison. The *in situ* water quality results were within the expected range of parameters for a freshwater system in New Jersey. Water temperature ranged from 10.1 to 11.2 degrees Celsius, salinity ranged from 0.11 to 0.12 parts per thousand (ppt), dissolved oxygen ranged from 10.3 to 10.9 mg per liter ( $\text{mg/L}$ ), pH ranged from 7.0 to 7.6, and the conductivity ranged from 0.170 to 0.197  $\text{mS/cm}$ .

##### 3.1.2 Surface Water

Surface water samples were collected from eight locations along Blackwater Branch, the Maurice River, and Union Lake (Figures 3-1 through 3-7). At each location, one surface water sample was collected prior to any disturbance of bottom sediment (referred to as sample one – Wat1) and the second surface water sample was collected at the same location as above after disturbance of the bottom sediment (referred to as sample two – Wat2), intended to simulate potential human exposure to arsenic during recreational contact. Therefore, a total of 16 surface water samples were collected from eight locations in the vicinity of the site. Four of the 18 surface water samples analyzed had detected concentrations of arsenic that were above the 10 ppb ( $\mu\text{g/L}$ ) USEPA Drinking Water Criterion for arsenic. The four exceedences occurred in the agitated water samples, with arsenic concentrations of 20 ppb at Station 7 (Sherman Avenue), 230 ppb at Station 8 (North End of Union Lake), 1,100 ppb at Station 9 (Union Lake Beach), and 19 ppb at Station 10 (South End of Union Lake). Station 9 and Station 10 had detected concentrations of arsenic below the 10 ppb USEPA Drinking Water Criterion in the pre-agitated (Wat1) samples. The remaining stations did not have detected concentrations of arsenic (Table 3-1). The pre-agitated water field duplicate taken at Station 8 (North End of Union Lake) had a non-detect of arsenic while the post-agitated water field duplicate taken at Station 9 (Union Lake Beach) had an arsenic concentration of 290  $\mu\text{g/L}$  (Table 3-1).



## **3.2 SEDIMENT AND SOIL**

### **3.2.1 Shallow Sediment**

Two types of shallow and nearshore (shore) sediment samples were collected, including in-stream and nearshore (shore) sediment samples (Figures 3-2 through 3-7). The results are presented in the following paragraphs and Table 3-2. The shallow sediment samples were intended to simulate potential human exposure to arsenic contaminated sediment during recreational contact (i.e., beach wading, playing in shallow near shore water, a special concern regarding children).

#### **3.2.1.1 In-Stream Sediment**

In-stream sediment samples (0-0.5 ft depth increment beneath the water/sediment interface) were collected from eight locations along Blackwater Branch, the Maurice River, and Union Lake (Figures 3-1 through 3-7). Arsenic was detected in the shallow sediment samples for seven of the eight locations, ranging from 0.79 mg/Kg to 330 mg/Kg (Table 3-2). At two locations, in-stream arsenic concentrations in sediment exceeded the Site Clean-up Level of 20 ppm (mg/Kg): Station 9 (Union Lake Beach) (330 ppm) and Station 10 (South End of Union Lake) (40 ppm). Arsenic was not detected in shallow sediment at Station 6 ("BareA" Beach).

#### **3.2.1.2 Nearshore (Shore) Sediment**

Nearshore (shore) sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake, 2-10 ft below the waterline, representing the 0-0.5 ft depth increment beneath the water/sediment interface (Figures 3-1 through 3-7). Arsenic was detected in six of the eight shore sediment samples, ranging from 1.0 mg/Kg to 280 mg/Kg (Table 3-2). At three locations, nearshore arsenic concentrations in sediment exceeded the Site Clean-up Level of 20 ppm for arsenic in solids. Arsenic exceeded the 20 ppm criterion at Station 3 (Blackwater Branch confluence) (21 ppm), Station 6 ("BareA" Beach) (280 ppm), and Station 8 (North End of Union Lake) (65 ppm).

### **3.2.2 Beach Soils**

Beach soils were sampled from a total of five locations along the Maurice River and Union Lake (Figures 3-2, 3-3, 3-4, and 3-7). Arsenic was only detected at one of the five beach locations (Station 9 – Union Lake Beach) at a concentration of 0.91 mg/Kg, which is well below the Site Clean-up Level of 20 ppm for arsenic in solids (Table 3-2).

## **3.3 QA/QC RESULTS**

The results for the QA/QC samples, including equipment blanks and field duplicates are provided in Tables 3-1 and 3-2, respectively, and are discussed in the following subsections.



### 3.3.1 Equipment Blanks

Arsenic was not detected at concentrations above the Method Detection Limit (MDL - 8 µg/L) in any of the equipment blanks. Therefore, it is unlikely that any contamination can be attributed to sampling equipment or collection and handling.

### 3.3.2 Field Duplicates

Field duplicate samples were collected simultaneously from the same sampling locations as sediment and water samples.

Relative percent differences (RPD) were calculated for field duplicate samples that had detected concentrations of arsenic. Following the protocol defined in Worksheet 12 of the *UFP/QAPP* (USACE 2009), the RPD was calculated for DUP-1, DUP-3, DUP-5, DUP-6, and DUP-8. RPDs were not calculated for duplicates and co-located samples with non-detect results. According to the *UFP/QAPP* (USACE 2009), the measurement performance criterion for sediment samples and aqueous samples was 25% RPD (QAPP Worksheets 12-1 and 12-2).

Each of the RPD's was less than 25% except for DUP-6. The RPD of -66.7% was out of compliance with the measurement performance criteria. The arsenic concentrations detected in the duplicate sample and its matching sample were close to the average reporting limit for sediment samples. The small difference in sample results translated to a high RPD. However, due to the heterogeneity of sediment, the RPD is not a significant deviation and the sample results are still acceptable. The arsenic concentrations for these matching samples were well below the site clean-up level.

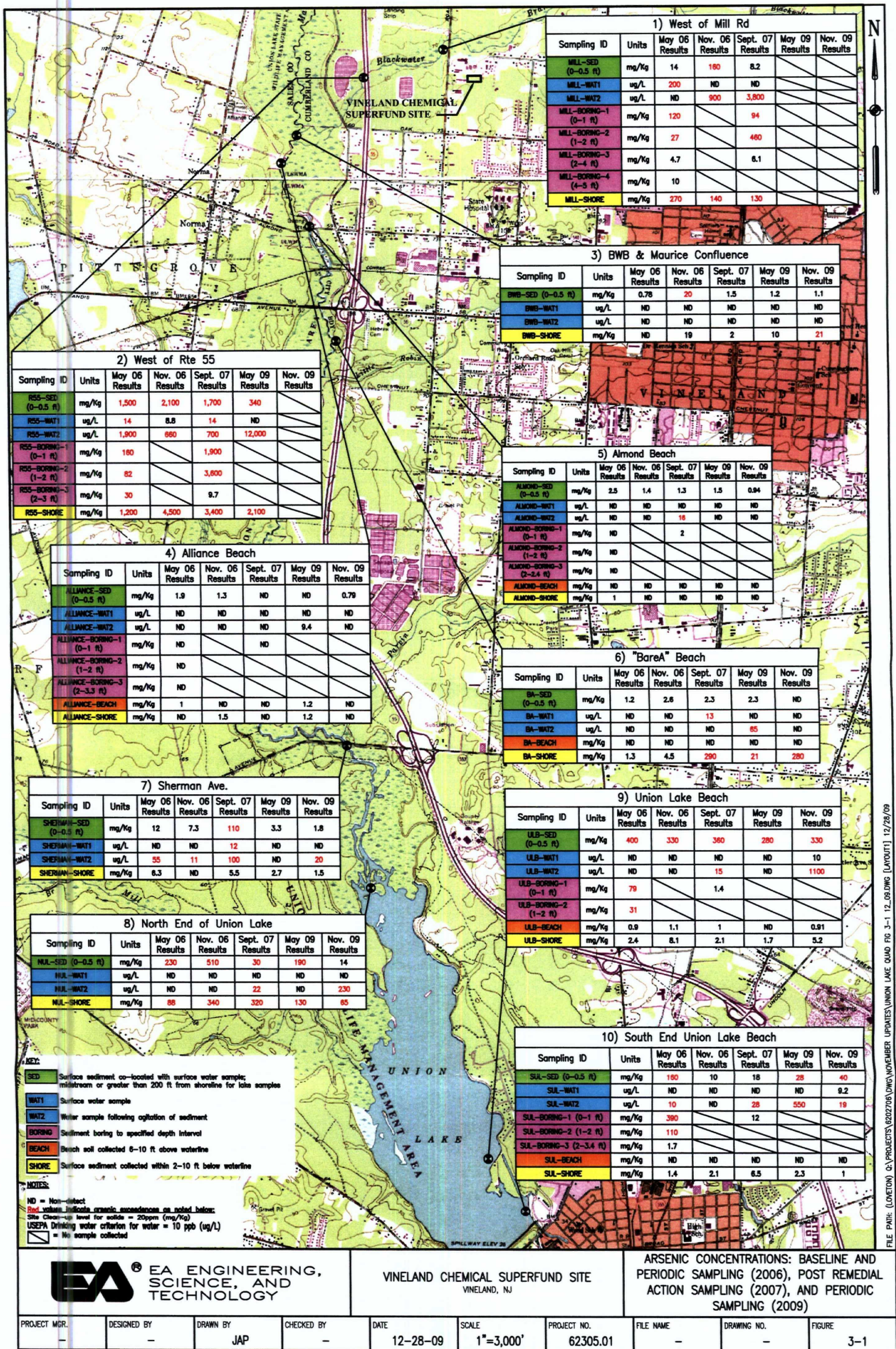
<u>Type of Sample</u>	<u>Duplicate # / Result</u>	<u>Matching Sampling ID / Result</u>	<u>RPD for detected analytes</u>
Sediment	DUP-1/(0.96 mg/Kg)	BWB-Sed /(1.1 mg/Kg)	-13.6%
Soil	DUP-2/(0.69 mg/Kg)	Alliance-Beach/(U)	-
Sediment	DUP-3/(21 mg/Kg)	BWB-Shore/(21 mg/Kg)	0%
Sediment	DUP-4/(U)	Almond-Shore/(U)	-
Sediment	DUP-5/(320 mg/Kg)	BA-Shore/(280 mg/Kg)	13.3%
Sediment	DUP-6/(0.9 mg/Kg)	Sherman-Sed/(1.8 mg/Kg)	-66.7%
Water	DUP-7/(U)	NUL-Wat1/(U)	-
Water	DUP-8/(290 µg/L)	NUL-Wat2/(230 µg/L)	23.1%
Soil	DUP-9/(U)	SUL-Beach/(U)	-

*U = non-detected arsenic concentration*

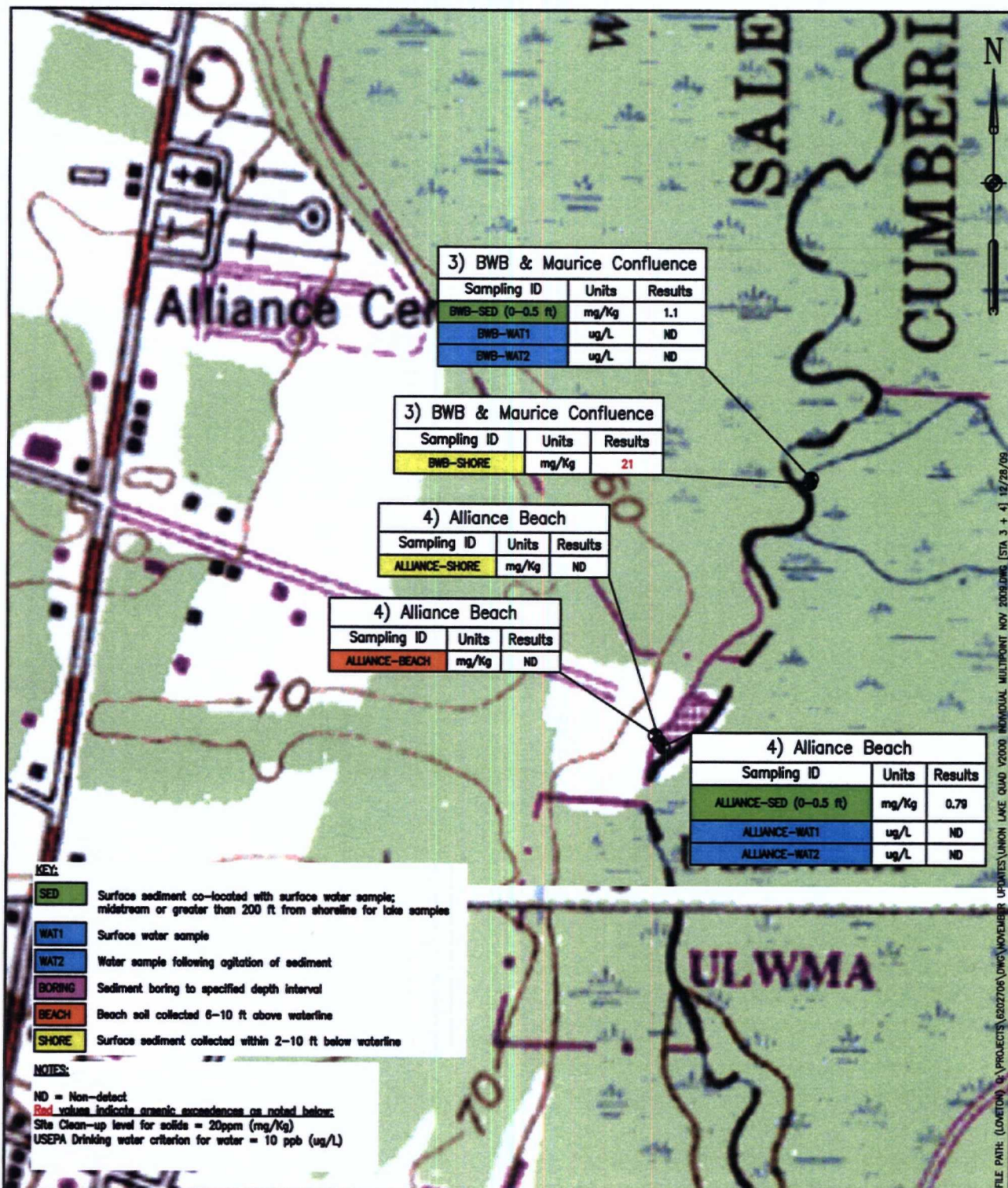
### 3.3.3 MS/MSD Samples

The Laboratory's established QC criteria were met for MS and MSD samples, including aqueous samples, soil samples, and sediment samples. These data were validated by the USEPA Region II DESA Laboratory.









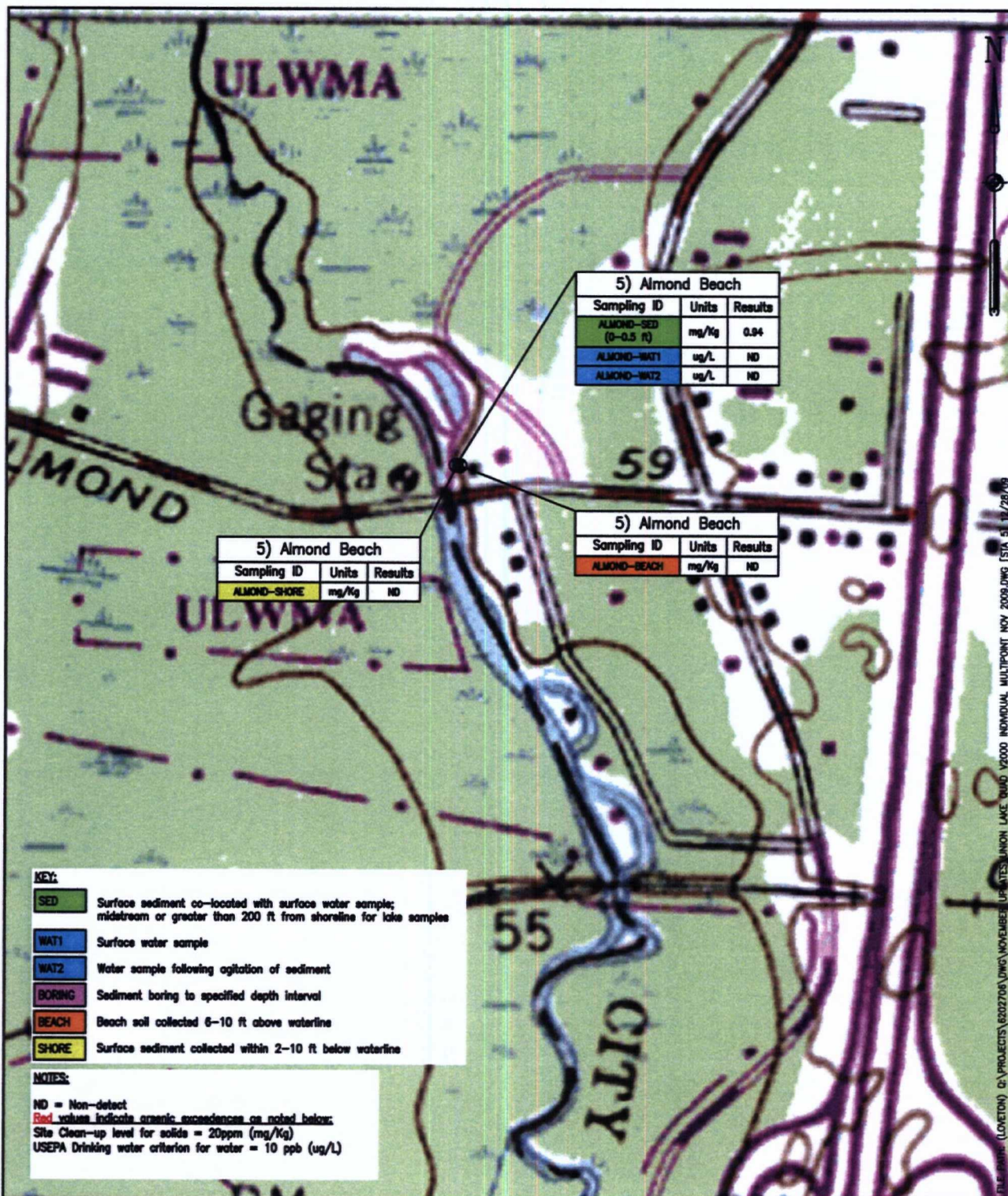
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VINELAND CHEMICAL SUPERFUND SITE  
VINELAND, NJ

PERIODIC SAMPLING-FALL 2009  
SAMPLE LOCATIONS  
3) BWB & MAURICE CONFLUENCE  
AND 4) ALLIANCE BEACH

PROJECT MGR -	DESIGNED BY -	DRAWN BY MP	CHECKED BY -	SCALE 1"=500'	DATE 12-28-09	PROJECT NO 62305.01	FIGURE 3-2
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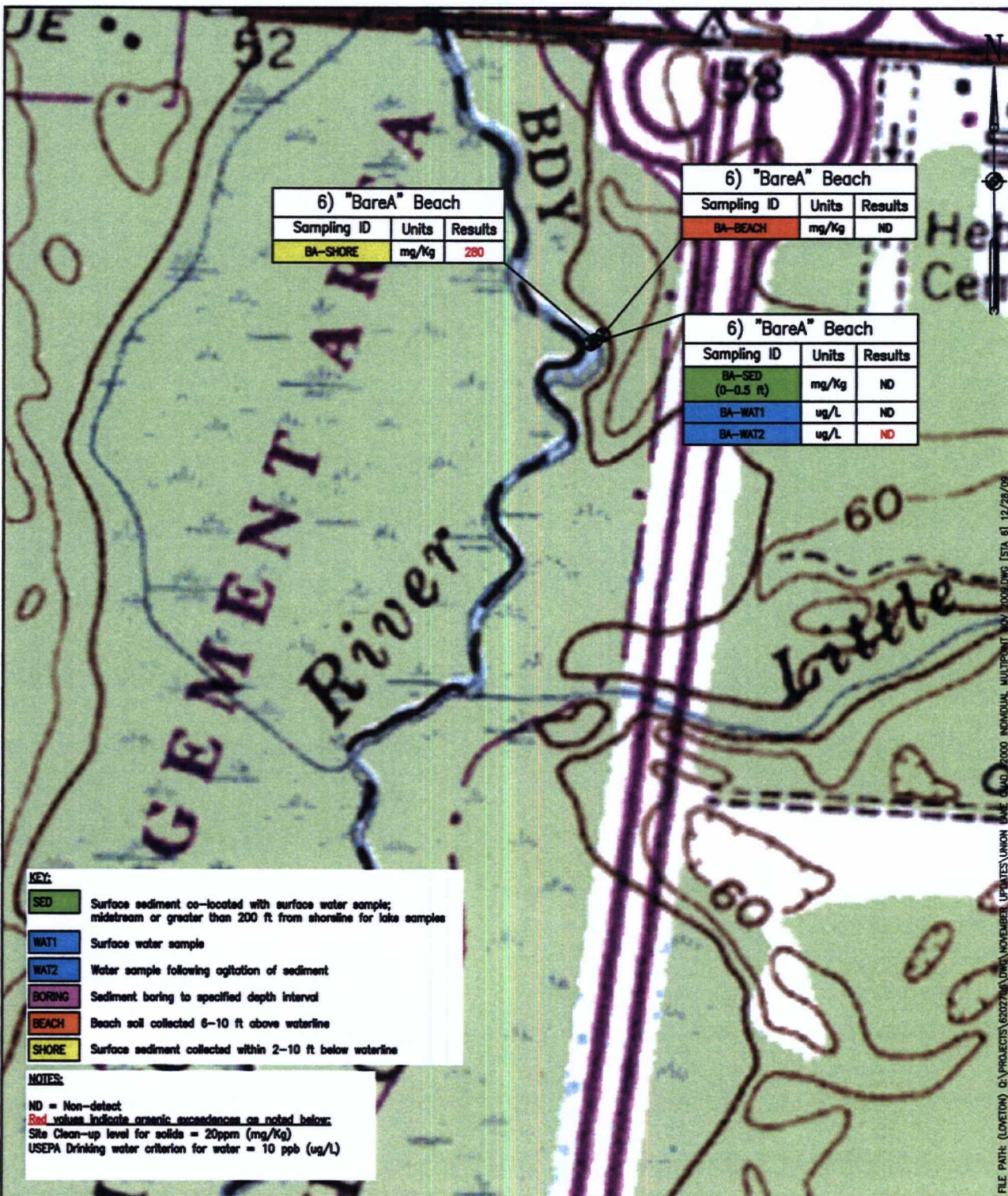




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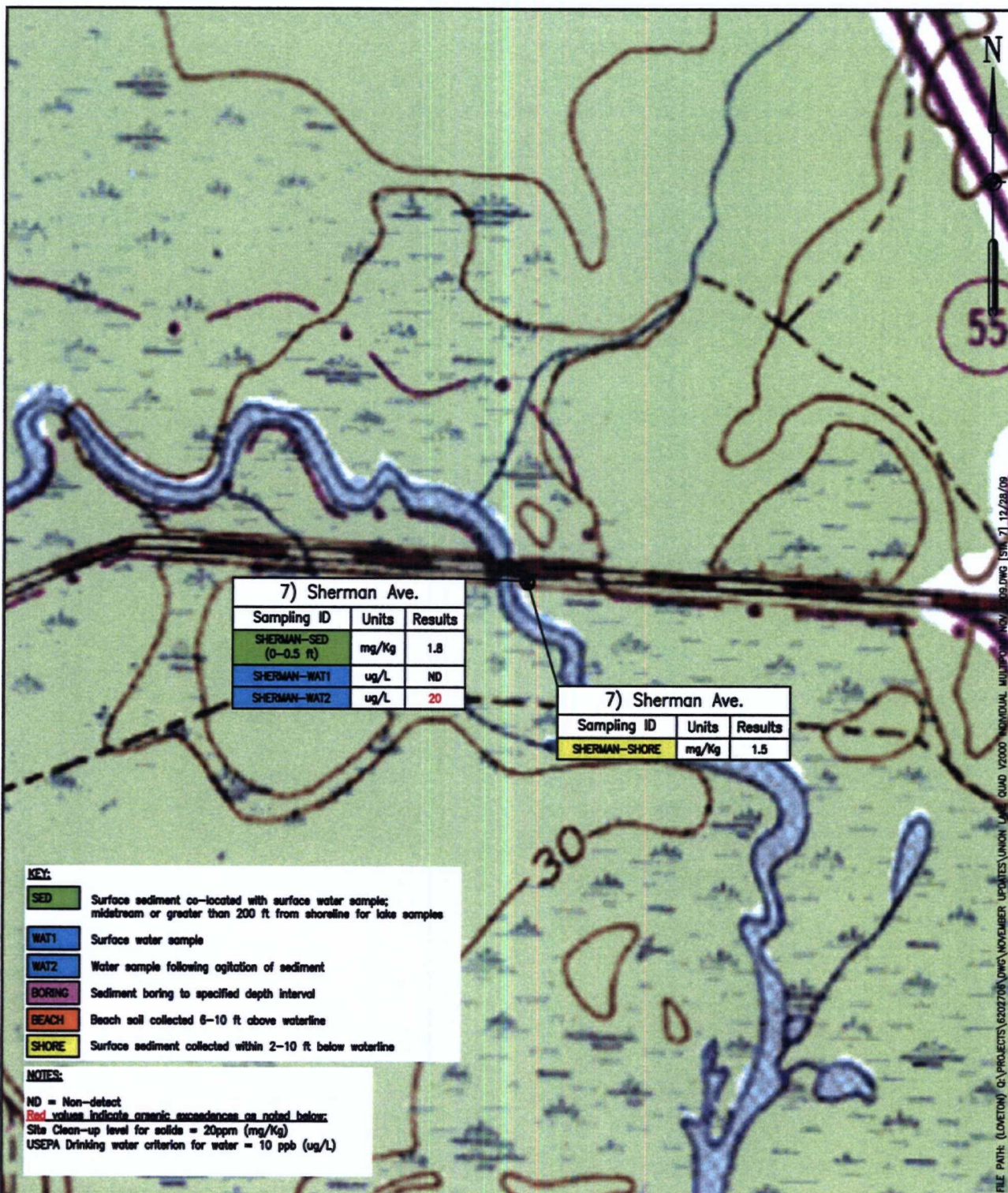
<b>EA</b> ® EA ENGINEERING, SCIENCE, AND TECHNOLOGY			VINELAND CHEMICAL SUPERFUND SITE VINELAND, NJ		PERIODIC SAMPLING—FALL 2009 SAMPLE LOCATION 5) ALMOND BEACH		
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
—	—	MP	—	1"=500'	12-28-09	62305.01	3-3





			VINELAND CHEMICAL SUPERFUND SITE VINELAND, NJ		PERIODIC SAMPLING--FALL 2009 SAMPLE LOCATION 6) "BARE A" BEACH		
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
-	-	MP	-	1"=500'	12-28-09	62305.01	3-4





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VINELAND CHEMICAL SUPERFUND SITE  
VINELAND, NJ

PERIODIC SAMPLING—FALL 2009  
SAMPLE LOCATION  
7) SHERMAN AVE.

PROJECT MGR

—

DESIGNED BY

—

DRAWN BY

MP

CHECKED BY

—

SCALE

1"=500'

DATE

12-28-09

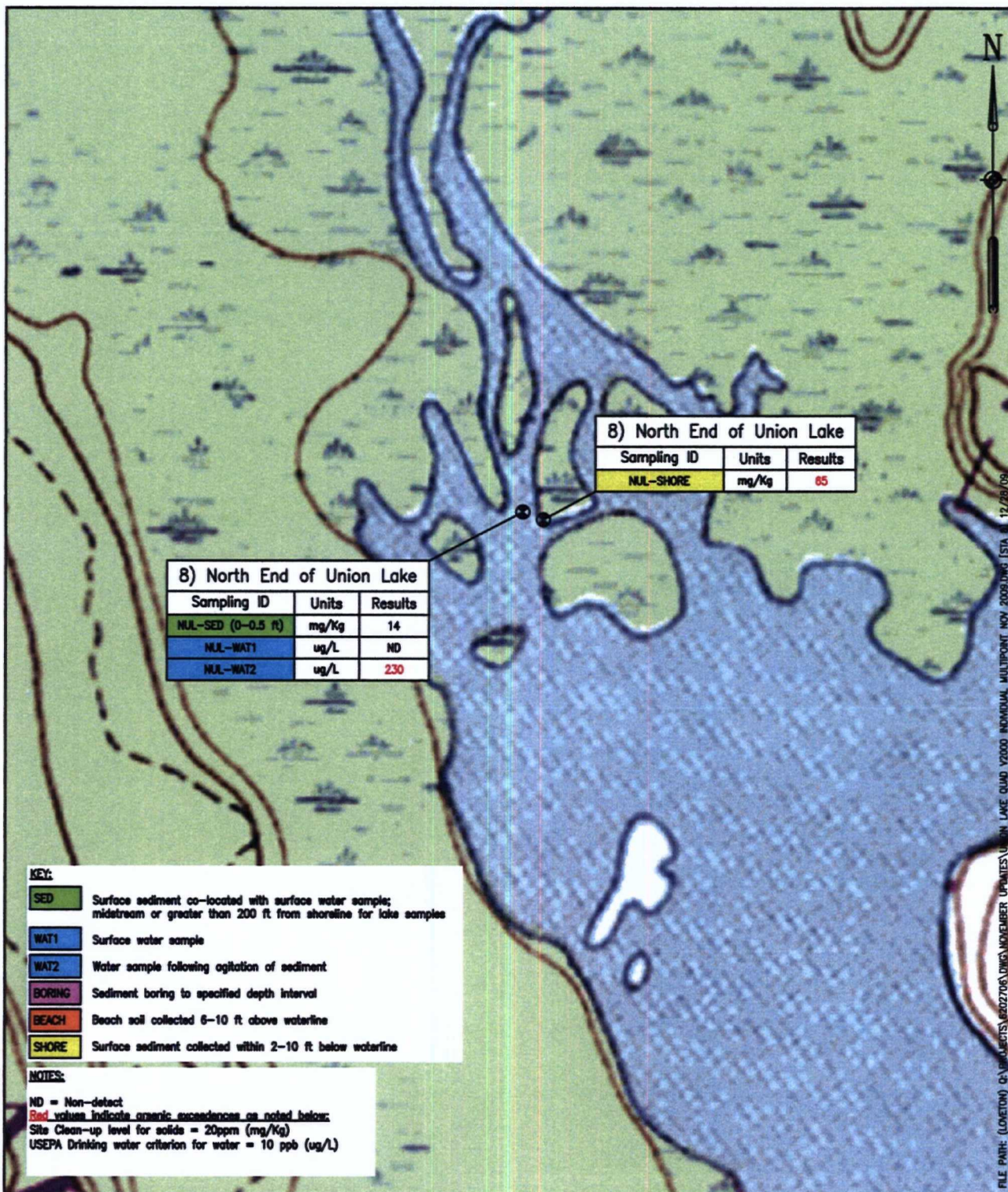
PROJECT NO

62305.01

FIGURE

3-5





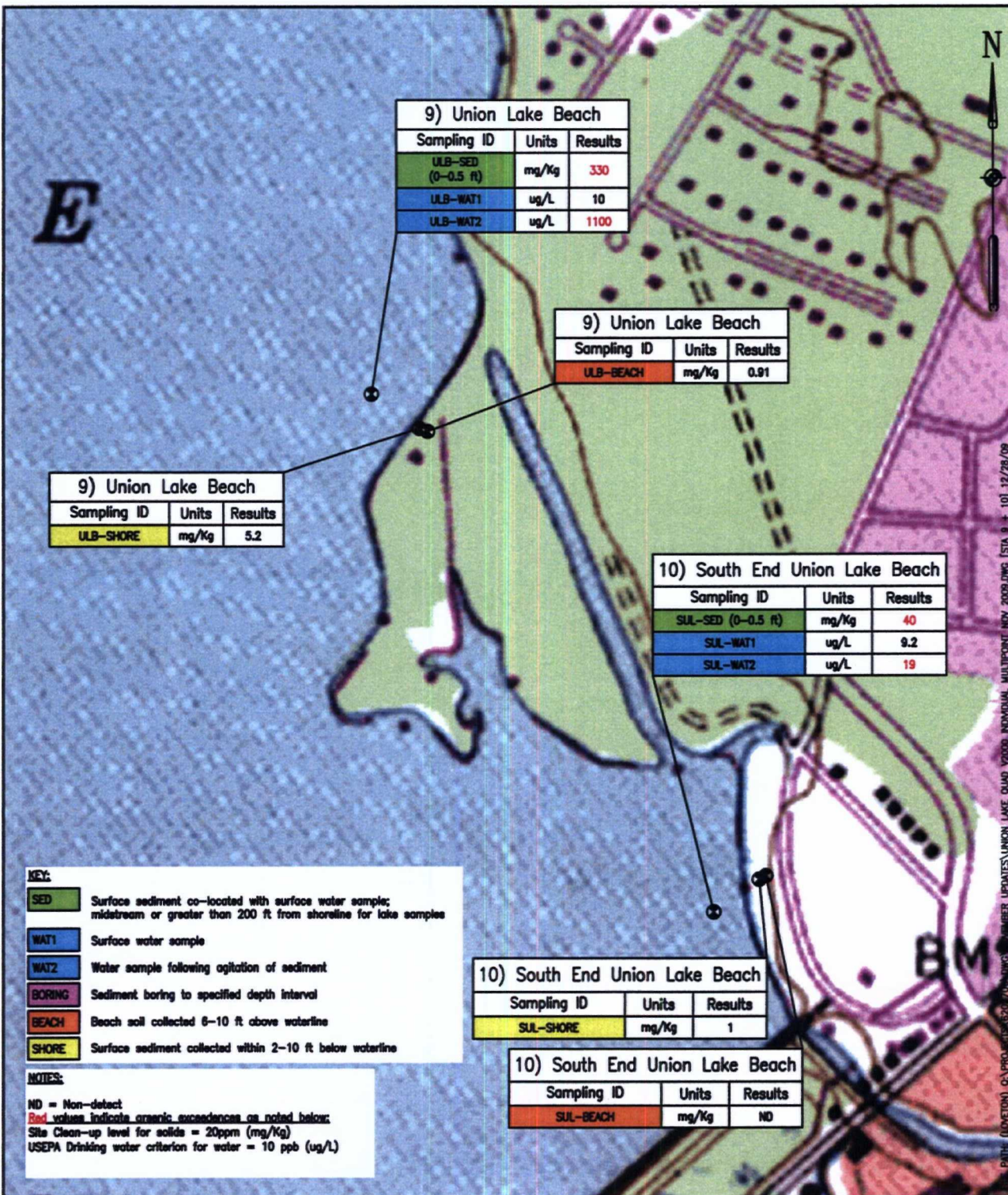
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TECHNOLOGY

VINELAND CHEMICAL SUPERFUND SITE  
VINELAND, NJ

PERIODIC SAMPLING-FALL 2009  
SAMPLE LOCATION  
8) NORTH END OF UNION LAKE

PROJECT MGR -	DESIGNED BY -	DRAWN BY MP	CHECKED BY -	SCALE 1"=500'	DATE 12-28-09	PROJECT NO 62305.01	FIGURE 3-6
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<b>EA</b> <small>EA ENGINEERING, SCIENCE, AND TECHNOLOGY</small>			<b>VINELAND CHEMICAL SUPERFUND SITE</b> VINELAND, NJ			<b>PERIODIC SAMPLING-FALL 2009</b> <b>SAMPLE LOCATIONS</b> <b>9) UNION LAKE BEACH AND 10)</b> <b>SOUTH END OF UNION LAKE BEACH</b>		
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE	
-	-	MP	-	1"=500'	12-28-09	62305.01	3-7	



**TABLE 3-1. ARSENIC CONCENTRATIONS (µg/L) IN WATER SAMPLES COLLECTED IN VICINITY OF  
VINELAND CHEMICAL SUPERFUND SITE, NOVEMBER 2009  
VINELAND PERIODIC SAMPLING - FALL 2009**

Sample Location	Station ID	Units	Average RL	Result
1) West of Mill Rd	-	-	-	-
2) West of Rte 55	-	-	-	-
3) BWB & Maurice Confluence	BWB-WAT1	ug/L	8	U
	BWB-WAT2	ug/L	8	U
4) Alliance Beach	ALLIANCE-WAT1	ug/L	8	U
	ALLIANCE-WAT2	ug/L	8	U
5) Almond Beach	ALMOND-WAT1	ug/L	8	U
	ALMOND-WAT2	ug/L	8	U
6) "BareA" Beach	BA-WAT1	ug/L	8	U
	BA-WAT2	ug/L	8	U
7) Sherman Ave.	SHERMAN-WAT1	ug/L	8	U
	SHERMAN-WAT2	ug/L		
8) North End of Union Lake	NUL-WAT1	ug/L	8	U
	NUL-WAT2	ug/L		
9) Union Lake Beach	ULB-WAT1	ug/L		<b>10</b>
	ULB-WAT2	ug/L		<b>10</b>
10) South End Union Lake Beach	SUL-WAT1	ug/L		<b>9.2</b>
	SUL-WAT2	ug/L		
Duplicates	DUP-7 (NUL-WAT1)*	ug/L	8	U
	DUP-8 (ULB-WAT2)*	ug/L		
Equipment Blank	PBlank-01	ug/L	8	U
	PBlank-02	ug/L	8	U
	BSBlank-01	ug/L	8	U
	BSBlank-02	ug/L	8	U
	TTBlank-01	ug/L	8	U

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values exceed the USEPA Drinking Water Criterion of 10 ug/L (ppb)

U = arsenic was analyzed, but not detected

\*Denotes cross-referenced sample location of blind duplicate sample

"-" = no sample collected

**TABLE 3-2. ARSENIC CONCENTRATIONS ( $\mu\text{g/L}$ ) IN SOIL AND SEDIMENT SAMPLES  
COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, NOVEMBER 2009  
VINELAND PERIODIC SAMPLING - FALL 2009**

Sample Location	Station ID	Units	Matrix	Average RL	Result
1) West of Mill Rd	-	-	-	-	-
2) West of Rte 55	-	-	-	-	-
3) BWB & Maurice Confluence	BWB-SED	mg/Kg	Sediment		<b>1.1</b>
	BWB-SHORE	mg/Kg	Sediment		
4) Alliance Beach	ALLIANCE-BEACH	mg/Kg	Soil	0.67	U
	ALLIANCE-SED	mg/Kg	Sediment		<b>0.79</b>
	ALLIANCE-SHORE	mg/Kg	Sediment	0.67	U
	ALMOND-BEACH	mg/Kg	Soil	0.65	U
5) Almond Beach	ALMOND-SED	mg/Kg	Sediment		<b>0.94</b>
	ALMOND-SHORE	mg/Kg	Sediment	0.68	U
	BA-BEACH	mg/Kg	Soil	0.59	U
6) "BareA" Beach	BA-SED	mg/Kg	Sediment	0.56	U
	BA-SHORE	mg/Kg	Sediment		
	SHERMAN-SED	mg/Kg	Sediment		<b>1.8</b>
7) Sherman Ave.	SHERMAN-SHORE	mg/Kg	Sediment		<b>1.5</b>
	NUL-SED	mg/Kg	Sediment		<b>14</b>
8) North End of Union Lake	NUL-SHORE	mg/Kg	Sediment		
	ULB-BEACH	mg/Kg	Soil		<b>0.91</b>
9) Union Lake Beach	ULB-SED	mg/Kg	Sediment		
	ULB-SHORE	mg/Kg	Sediment		<b>5.2</b>
	SUL-BEACH	mg/Kg	Soil	0.58	U
10) South End Union Lake Beach	SUL-SED	mg/Kg	Sediment		
	SUL-SHORE	mg/Kg	Sediment		<b>1</b>
Duplicate	DUP-1 (BWB-SED)*	mg/Kg	Sediment		<b>0.96</b>
	DUP-2 (ALLIANCE-BEACH)*	mg/Kg	Soil		<b>0.69</b>
	DUP-3 (BWB-SHORE)*	mg/Kg	Sediment		
	DUP-4 (ALMOND-SHORE)*	mg/Kg	Sediment	0.72	U
	DUP-5 (BA-SHORE)*	mg/Kg	Sediment		
	DUP-6 (SHERMAN-SED)*	mg/Kg	Sediment		<b>0.9</b>
	DUP-9 (SUL-BEACH)*	mg/Kg	Soil	0.61	U

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values are equivalent to or exceed the Site Clean-up Level of 20

U = arsenic was analyzed, but not detected

\*Denotes cross-referenced sample location of blind duplicate sample

"-" = no sample collected

#### 4. SUMMARY AND COMPARISONS TO PREVIOUS DATA

Overall, results of the Periodic Sampling – Fall 2009 indicated one more exceedance of the arsenic criterion for agitated water samples than for the previous sampling event (Periodic Sampling – Spring 2009). Arsenic concentrations in agitated water samples exceeded the 10 µg/L criterion at four of the eight sampling locations. The last sampling event, Periodic Sampling – Spring 2009, had exceedances in agitated water samples at three of nine locations. The highest concentration of arsenic in an agitated water sample for Fall 2009 was at Station 9 (Union Lake Beach) with a value of 1,100 µg/L.

As was noted in Section 1.4, Station 1 (West of Mill Road) and Station 2 (West of Route 55) were not sampled due to remediation activities and stream realignment at these locations. Stations located downstream from Station 2 and upstream of Union Lake did not have arsenic concentrations that exceeded the Site Clean-up Level except the shore sample at Station 6 (“BA” Beach) which had a value of 21 mg/kg. The stations located along Union Lake, including Station 8 (North End of Union Lake), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake) had arsenic concentrations in sediments and shore samples that exceeded the Site Clean-up Level of 20 ppm. The sediment samples at Station 9 and Station 10 had values of 330 mg/Kg and 40 mg/Kg, respectively. The nearshore (shore) sample at station 8 had a value of 65 mg/Kg. These trends in Union Lake may be attributable to the proportion of fine silt/clays in the sediment samples; arsenic is strongly sorbed onto fine particulates, including silt (Bodek et. al 1988). The arsenic that originates from upstream sources may be transported downstream via particulates which settle out in the lake depositional areas. Previous reports for the site have stated that sediment in the Maurice River and Union Lake contains a high content of organic matter (USEPA 1999). Arsenic concentrations from the five beach locations [Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 (“BareA” Beach), Station 9 (Union Lake Beach), and Station 10 (South End Union Lake Beach)] were either  $\leq 0.91$  mg/Kg or below the analytical detection limit.

Below Station 2 (West of Rte. 55), additional water flow from the Maurice River and other tributaries flowing into the Maurice River may transport arsenic that is bound to fine particulates further downstream. Previously in the May 2006 and November 2006 Sampling events, arsenic concentrations in sediments, water, and beach soil did not exceed criteria at Station 4 (Alliance Beach), Station 5 (Almond Beach), or Station 6 (“BareA” Beach). In September 2007, the first exceedance of applicable criteria occurred at Station 5 (Almond Beach) in the agitated water sample and at Station 6 (“BareA” Beach) in both a surface water sample and a nearshore (shore) sediment sample. During sampling in May 2009, the only samples to exceed the Site Clean-up Levels south of Station 2 (West of Route 55) and north of Union Lake were the agitated water sample (Wat2) and the shore (sediment) samples at Station 6; the arsenic concentrations were 65 ug/L and 21 mg/Kg, respectively. Sampling in November 2009 had three exceedances of criteria; the agitated water sample (Wat2) at Station 7 (Sherman Avenue) and the shore samples at Station 4 and Station 6.

Overall, for all stations and matrices, during the May 2006 Baseline Sampling event, the frequency of arsenic detection was 57 percent, with 32 percent of analyzed samples exceeding the applicable criteria for arsenic. Comparatively, during the November 2006 Periodic Sampling

event, the frequency of arsenic detection was 53 percent, with 27 percent of analyzed samples exceeding the applicable criteria for arsenic. During the September 2007 Post Remedial Action Sampling event, the frequency of arsenic detection was 68 percent, with 42 percent of analyzed samples exceeding the applicable criteria for arsenic. The increased frequency of detection and frequency of exceeding applicable criteria that were observed in the September 2007 Post Remedial Action Sampling could potentially be attributed to the excavation activities associated with the remedial actions currently occurring at the site. The frequency of detection during the May 2009 sampling event was 49 percent, with 23 percent of analyzed samples exceeding the applicable criteria for arsenic. Periodic Sampling – Fall 2009 had a frequency detection of 54 percent, with 24 percent of analyzed samples exceeding the applicable criteria for arsenic.

#### **4.1 Summary of Periodic Sampling – Fall 2009 Arsenic Results by Station**

##### **Station 1 – West of Mill Rd (see Figure 3-1)**

Station 1 was not sampled during the Fall 2009 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

##### **Station 2 – West of Rte 55 (see Figure 3-1)**

Station 2 was not sampled during the Fall 2009 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

##### **Station 3 – BWB & Maurice Confluence (see Figures 3-1 and 3-2)**

Arsenic was detected above the Site Clean-up Level of 20 ppm in the nearshore (shore) sediment sample; a concentration of 21 mg/Kg was detected. None of the other samples exceeded criteria at this location.

##### **Station 4 – Alliance Beach (see Figures 3-1 and 3-2)**

Arsenic was not detected in the water, shore, or beach samples. Arsenic was detected in the surficial mid-stream sediment sample at 0.79 mg/Kg.

##### **Station 5 – Almond Beach (see Figures 3-1 and 3-3)**

Arsenic was not detected in the water, shore, or beach samples. Arsenic was detected in the surficial mid-stream sediment sample at 0.94 mg/Kg.

##### **Station 6 – “BareA” Beach (see Figures 3-1 and 3-4)**

Arsenic was not detected in the water, sediment, or beach samples. Arsenic was detected in the sediment nearshore (shore) sample at 280 mg/Kg which exceeded the Site Clean-up Level of 20 ppm by a factor of 14.

##### **Station 7 – Sherman Ave. (see Figures 3-1 and 3-5)**

The arsenic concentration in the agitated water sample was detected at 20 ug/L; the USEPA Drinking Water Criterion for water is 10 ug/L. Arsenic was also detected in the sediment sample at 1.8 mg/Kg and in the shore sample at 1.5 mg/Kg.

#### Station 8 – North End of Union Lake (see Figures 3-1 and 3-6)

The arsenic concentration in the shore sediment sample exceeded the Site Clean-up Level of 20 ppm; the concentration of 65 mg/Kg exceeded the Site Clean-up Level by a factor of 3.25. Arsenic was detected in the sediment sample at 14 mg/Kg. The agitated water sample had an arsenic concentration of 230 ug/L which exceeded the USEPA Drinking Water Criteria of 10 ug/L by a factor of 23.

#### Station 9 – Union Lake Beach (see Figures 3-1 and 3-7)

Arsenic was detected in both the pre-agitated and agitated water samples. The pre-agitated water sample had a concentration of 10 ug/L; the agitated water sample had a concentration of 1100 ug/L, a factor of 110 above the Drinking Water Criteria of 10 ug/L. The sediment sample had an arsenic concentration of 330 mg/Kg which exceeded the Site Clean-up Level by a factor of 16.5. Arsenic was also detected at levels below the Site Clean-up Level in the shore and beach samples. The shore sample had a concentration of 5.2 mg/Kg and the beach sample had a concentration of 0.91 mg/Kg.

#### Station 10 – South End of Union Lake Beach (see Figures 3-1 and 3-7)

Arsenic was detected in the agitated water sample at a concentration of 19 ug/L; this exceeded the Drinking Water Criteria by a factor of 1.9. The sediment sample had an arsenic concentration of 40 mg/Kg which exceeded the Site Clean-up Level by a factor of 2. Arsenic was also detected in the shore sample at a concentration of 1 mg/Kg. Arsenic was not detected in the beach sample at this location.

### **4.2 Comparison of November 2009 Arsenic Results to May 2009, September 2007, November 2006, and May 2006 Arsenic Results**

The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain from Mill Road to the Maurice River Parkway (west of Route 55). The baseline sampling conducted in May 2006 and the November 2006 Periodic Sampling was conducted during the excavation/construction activities. Sampling in September 2007 occurred during remediation of the Blackwater Branch and floodplain east of Mill Road and adjacent to the Vineland Chemical Superfund site. Sampling in May 2009 occurred during remediation of the Blackwater Branch west of Mill Road to Route 55. During sampling in November 2009, remediation activities had extended from west of Mill Road to west of Route 55 down to the Maurice River Parkway. The results from the previous sampling events are compared to the results from the Periodic Sampling – Fall 2009 (November 2009).

In the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, and the September 2007 Post Remedial Action Sampling, arsenic concentrations were analyzed in sediments, soil, and water collected at the same ten locations in and near waterways located adjacent to the site. Both the May 2006 Baseline Sampling and the September 2007 Post Remedial Action Sampling included the collection and analysis of deep sediment cores; the November 2006 Periodic Sampling effort did not include the collection and analysis of deep sediment cores. With the exception of core sampling and analysis and the exclusion of Station 1 (West of Mill Road) and Station 2 (West of Route 55), the sampling scheme and sampling locations for the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial

Action Sampling, the Periodic Sampling – Spring 2009, and the Periodic Sampling – Fall 2009 were identical. The following paragraphs and Table 4-1 compare the results of the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, and the Periodic Sampling – Fall 2009 for sediment, soil, and water samples.

#### May and November 2006, September 2007, May and November 2009 Arsenic Surface Water Data

The May 2006 results indicated that five of 20 surface water samples exceeded the applicable criteria, the November 2006 results indicated that only three of 20 surface water samples exceeded the applicable criterion, and the September 2007 results indicated that ten of 20 surface water samples exceeded the applicable criterion. Results of the May 2009 sampling showed that three of 18 surface water samples exceeded the USEPA Drinking Water Criterion of 10 µg/L. November 2009 results showed that four of 16 samples exceeded the USEPA Drinking Water Criterion. Surface water arsenic concentrations that were equivalent to or exceeded the USEPA Drinking Water Criterion of 10 µg/L ranged from 10 to 1,900 µg/L for the May 2006 sampling, from 11 to 900 µg/L for the November 2006 sampling, from 12 to 3,800 µg/L for the September 2007 sampling, and from 65 to 12,000 µg/L for the May 2009 sampling. In November 2009, the concentrations that were equivalent to or exceeded the 10 µg/L criterion ranged from 19 to 1,100 µg/L.

Data for each of the five sampling events indicated that the stations with the highest arsenic concentrations were located directly downstream of the site – Station 1 (West of Mill Rd.) and Station 2 (West of Rte. 55). Generally, for the November 2006 Periodic Sampling and May 2009 sampling, only the agitated water samples (versus surface water samples) exceeded the USEPA Drinking Water Criterion of 10 µg/L (ppb). In September 2007, there were substantially more exceedences of arsenic in the agitated water samples at the majority of the stations. First-time exceedences of the USEPA Drinking Water Criterion for arsenic in surface water occurred at Station 5 (Almond Beach), Station 8 (North End of Union Lake), and Station 9 (Union Lake Beach) in September 2007. In May 2009 and November 2009 only agitated water samples exceeded the USEPA Drinking Water Criterion.

#### May and November 2006, September 2007, and May and November 2009 Arsenic Mid-Stream Sediment (0-0.5ft) Data

The May 2006 results indicated that four of 10 sediment samples exceeded the applicable criterion of 20 ppm, the November 2006 results indicated that five of 10 sediment samples exceeded the applicable criterion, and the September 2007 results indicated that four of 10 sediment samples exceeded the applicable criterion. In May 2009, four of 9 sediment samples exceeded the applicable criterion. Two of 8 samples exceeded the applicable criterion in November 2009. Arsenic concentrations that exceeded the Site Clean-up Level of 20 ppm ranged from 160 to 1,500 mg/Kg for the May 2006 results, ranged from 20 to 2,100 mg/Kg for the November 2006 results, ranged from 30 to 1,700 mg/Kg for the September 2007 results, and ranged from 28 to 340 mg/Kg for the May 2009 results. The arsenic concentrations exceeding the applicable criterion in November 2009 were 330 mg/Kg at Station 9 (Union Lake Beach) and 40 mg/Kg at Station 10 (South End of Union Lake).

**May and November 2006, September 2007, and May and November 2009 Arsenic Nearshore (Shore) Sediment (0-0.5ft) Data**

Shore stations from Station 1 (West of Mill Rd.), Station 2 (West of Rte. 55), and Station 8 (North End of Union Lake) exceeded the Site Clean-up Level of 20 ppm for the May 2006, November 2006, and September 2007 sampling events. For the May 2009 sampling, Station 2 and Station 8 exceeded the applicable criterion. In September 2007 and May 2009, the shore sample for Station 6 ("BareA" Beach) also exceeded the criterion. Results from the November 2009 sampling show that Station 3 (Blackwater Branch confluence), Station 6 ("BareA" Beach), and Station 8 (North End of Union Lake) exceeded the criterion. Arsenic concentrations in the shore sediments that exceeded the Site Clean-up Level of 20 mg/Kg (ppm) ranged from 88 to 1,200 mg/Kg, 140 to 4,500 mg/Kg, and 110 to 3,400 mg/Kg for the May 2006, November 2006, and September 2007 events, respectively. The range for May 2009 was 21 to 2,100 mg/Kg and the range for November 2009 was 21 to 280 mg/Kg.

**May and November 2006, September 2007, and May and November 2009 Arsenic Beach Soil (0-0.5ft) Data**

Detected concentrations in May 2006, November 2006, September 2007, May 2009, and November 2009 were either comparable to or lower than those previously reported for all five beach stations. None of the 2006, 2007, and 2009 beach samples exceeded the Site Clean-up Level of 20 mg/kg for arsenic in soil.

#### **4.3 Comparison of Arsenic Results to Historical Data**

During 1992 and from 1994 through 1999, water, soil, and sediment samples were collected in the vicinity of and downstream of the Vineland site at beach stations for arsenic analyses (USEPA/ERTC 1999). These data were collected to evaluate the results against human health risk-based action levels and were part of an annual monitoring program performed at beaches along the Maurice River and Union Lake (USEPA/ERTC 1999). Data were collected from five beach locations including Alliance Beach (Station 4), Almond Beach (Station 5), "BareA" Beach (Station 6), Union Lake Beach (Station 9), and South End Union Lake Beach (Station 10). Each of the matrices (water, soil, and sediment) was not collected at each station every year. From 1992 and 1994 through 1999, no discernable trends in the historical arsenic data were evident; the concentration of arsenic in each matrix appeared to remain relatively constant over time (USEPA/ERTC 1999). The 1999 report that contains historical arsenic data for the 1992 and 1994 through 1999 is provided in Appendix D. These data were compared to data from the 2006, 2007, and 2009 sampling events.

The historical arsenic data for the five stations (listed above) were compared to the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, and the Periodic Sampling – Fall 2009 for surface water, beach soils, and surficial sediment arsenic concentrations (Tables 4-2 through 4-4 and Figures 4-1 through 4-3, respectively). The following paragraphs compare the historical arsenic data (1992 and 1994 through 1999) to the data collected in May 2006, November 2006, September 2007, May 2009, and November 2009 by matrix (water, soil, and sediment) and by station. Five of the ten total stations that were sampled in the May and November 2006, September 2007, May 2009, and November 2009 sampling surveys were also sampled in 1992

and 1994 through 1999; the five stations included in the 2006, 2007, and 2009 surveys that were not previously sampled (Stations 1, 2, 3, 7, and 8) are not included in this discussion.

#### Comparisons to Historical Arsenic Surface Water Data (1992, 1994 through 1999, 2006, 2007, and 2009)

Throughout the period of 1992 and 1994-1999, arsenic concentrations in surface waters at Station 4 (Alliance Beach), Station 5 (Almond Beach), and Station 6 ("BareA" Beach) were variable and substantially exceeded the current USEPA Drinking Water Criterion of 10 ppb. Arsenic concentrations in surface waters at Station 9 (Union Lake Beach) slightly declined from 1996 (above criterion) through 1999 (below criterion). The arsenic concentration in surface water at Station 10 (South End of Union Lake Beach) was above the criterion in both 1998 and 1999. Surface water data from samples collected in both May 2006 and November 2006 indicated that arsenic was not detected in the surface waters at each of these five previously sampled locations (Stations 4, 5, 6, 9, and 10), with the exception of Station 10 (South End of Union Lake Beach) in May 2006, when arsenic in the agitated water sample was equivalent to the USEPA Drinking Criterion. However, in September 2007, there were several exceedences of the arsenic criterion in surface water. The majority of these exceedences corresponded to agitated water samples. During the May 2009 sampling only two agitated samples exceeded the arsenic criterion. The exceedences were found at Station 6 and Station 10. November 2009 sampling resulted in two agitated water samples that exceeded the arsenic criterion; Station 9 had an arsenic concentration of 1,100 µg/L and Station 10 had a concentration of 19 µg/L. The November 2009 arsenic concentration of 1,100 µg/L at Station 9 was the highest concentration measured between 1992 and 2009. Table 4-2 and Figure 4-1 show the comparisons of data results from 1992 to November 2009.

#### Comparisons to Historical Beach Soil Data (1992, 1994 through 1999, 2006, 2007, and 2009)

None of the beach soil samples collected in 1992, 1994 through 1999, and 2006 exceeded the Site Clean-up Level of 20 ppm for arsenic at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake Beach). Detected concentrations in May 2006, November 2006, September 2007, May 2009, and November 2009 were either comparable to or lower than those previously reported for each of the five stations. None of the 2006, 2007, and 2009 samples exceeded the Site Clean-up Level of 20 ppm. Table 4-3 and Figure 4-2 present the comparisons of beach soil data results from 1992 to November 2009.

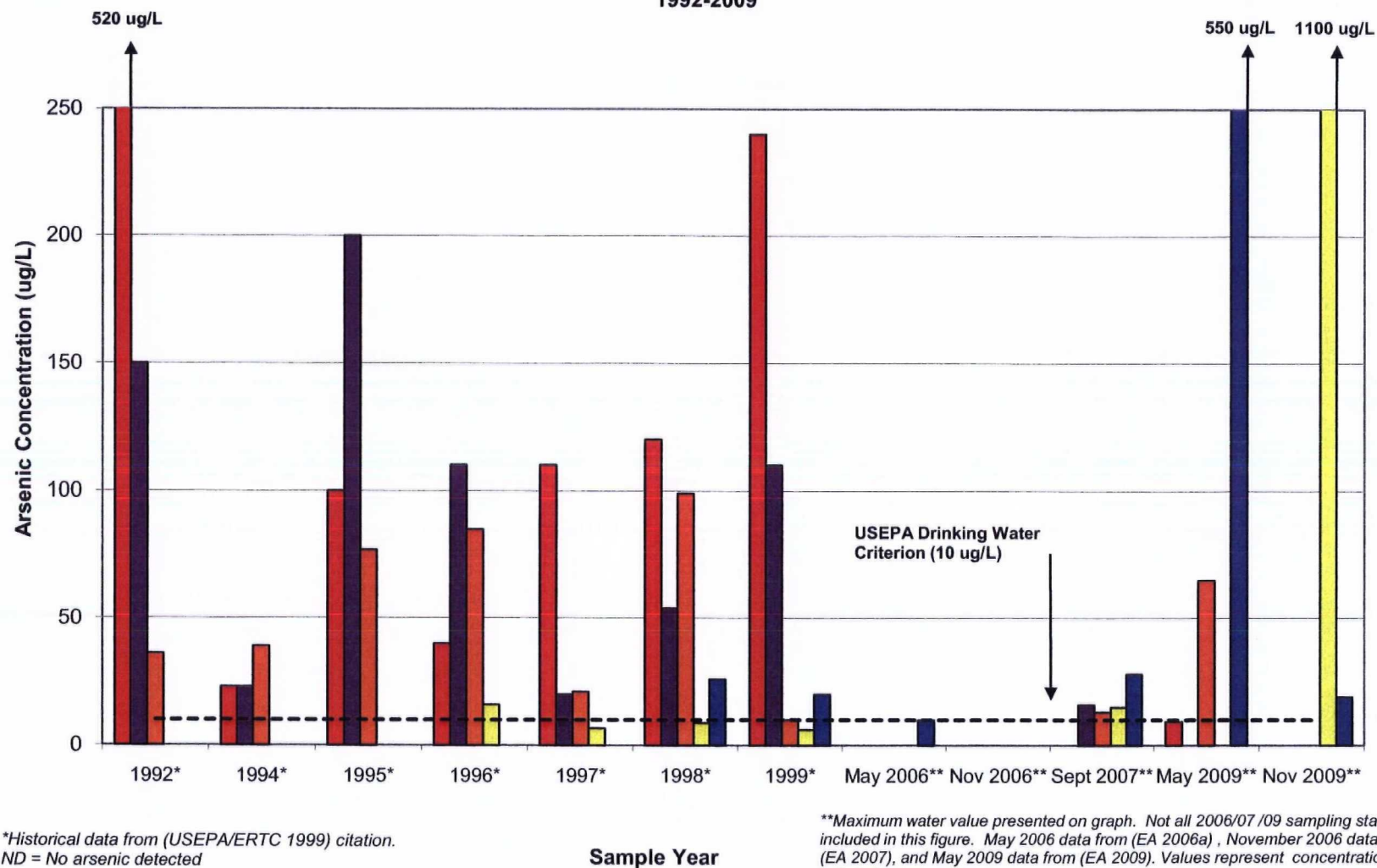
#### Comparisons to Historical Surface Sediment Data (1992, 1994 through 1999, 2006, 2007, and 2009)

Throughout the period of 1992 and 1994-1999, arsenic concentrations were below the Site Clean-up Level of 20 ppm at each of the five stations, with the exception of Station 6 ("BareA" Beach) in 1998. Results from samples collected between May 2006 and November 2009 indicated that arsenic concentrations in surficial sediment (collected greater than 200 ft from the shoreline) at Station 9 (Union Lake Beach) and Station 10 (South End of Union Lake Beach) were substantially higher than concentrations previously reported in 1992 and 1994-1999. The data from May 2006 to May 2009 show a slight decrease in arsenic concentrations for each successive sampling event. Results from November 2009 indicate an increase in arsenic



concentration at Station 9 and Station 10 compared to May 2009 results. Table 4-4 and Figure 4-3 show the comparisons of surficial sediment data results from 1992 to November 2009.

**Figure 4-1. Arsenic Concentrations ( $\mu\text{g/L}$ ) in Water Collected in the Vicinity of Vineland Chemical Superfund Site, 1992-2009**

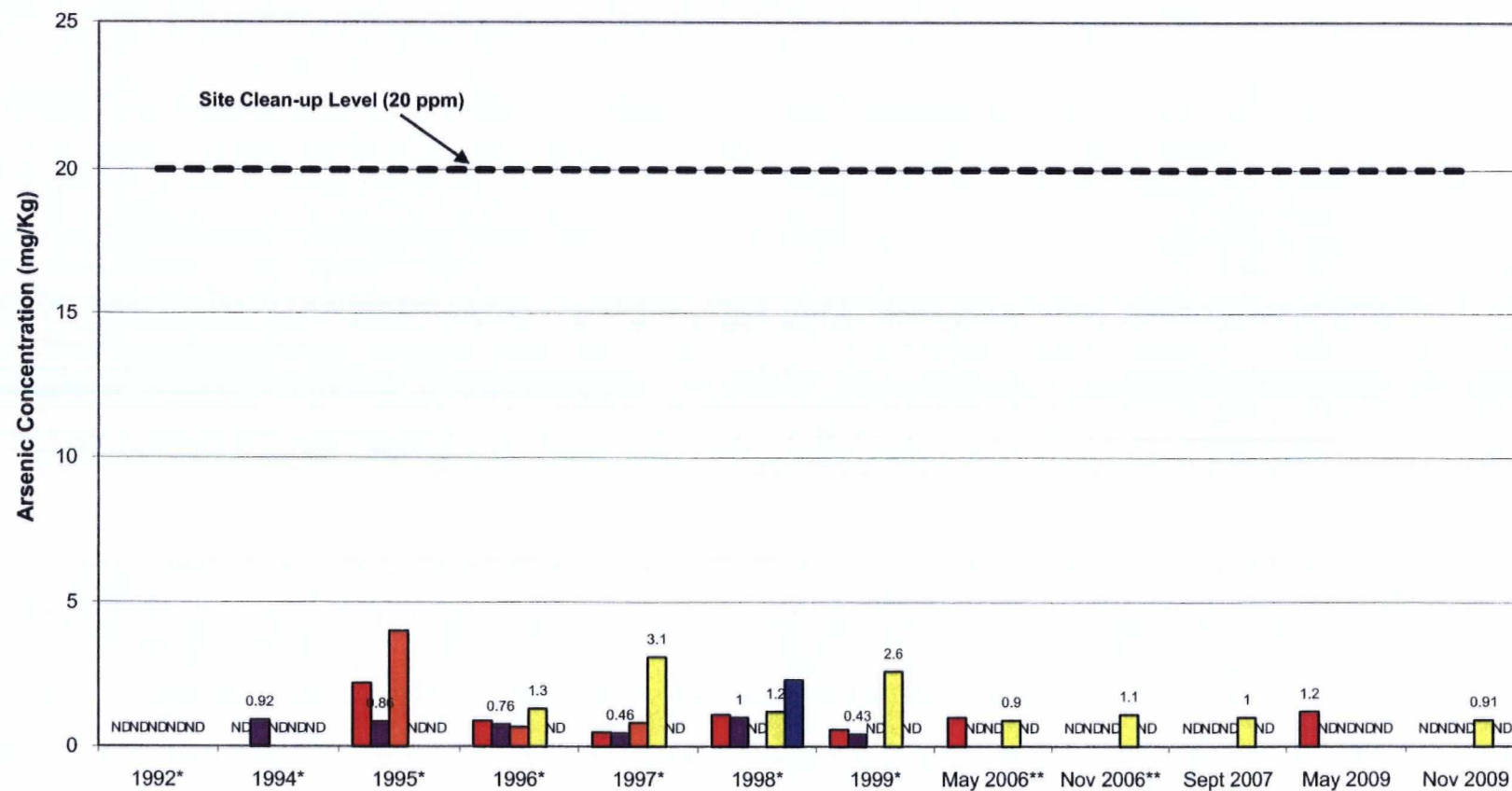


\*Historical data from (USEPA/ERTC 1999) citation.  
ND = No arsenic detected

\*\*Maximum water value presented on graph. Not all 2006/07/09 sampling stations included in this figure. May 2006 data from (EA 2006a), November 2006 data from (EA 2007), and May 2009 data from (EA 2009). Values represent concentrations in agitated water samples.

4) Alliance Beach ( $\mu\text{g/L}$ )      5) Almond Beach ( $\mu\text{g/L}$ )      6) BA Beach ( $\mu\text{g/L}$ )  
9) Union Lake Beach ( $\mu\text{g/L}$ )      10) South End Union Lake Beach ( $\mu\text{g/L}$ )      --- USEPA Drinking Water Criterion (ppb)

**Figure 4-2. Arsenic Concentrations (mg/Kg) in Beach (Soil) Samples Collected in the Vicinity of Vineland Chemical Superfund Site, 1992-2009**



\*Historical data from (USEPA/ERTC 1999) citation.

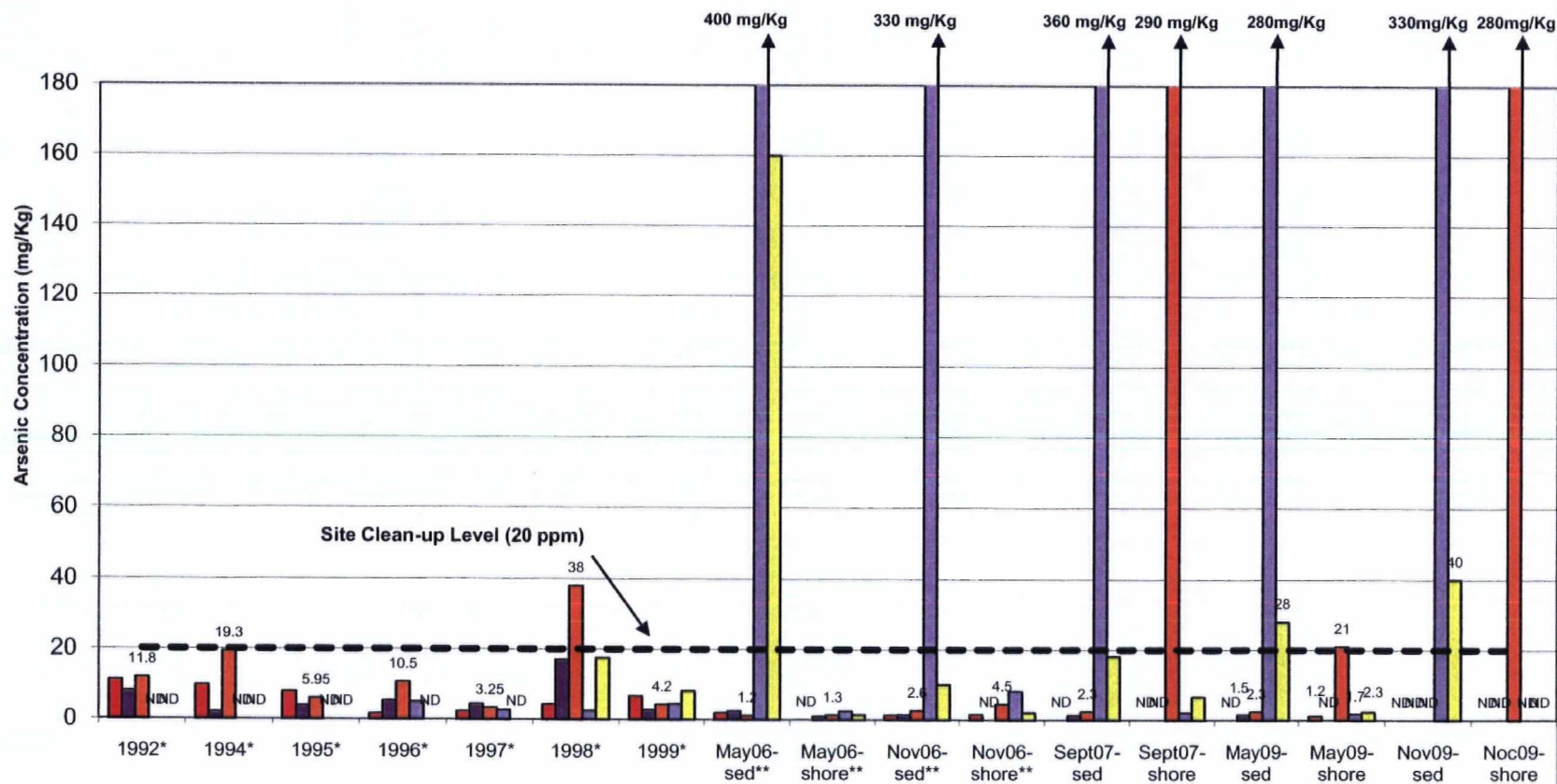
\*\*May 2006 data from (EA 2006a) and November 2006 data from (EA 2007).

Sample Year

ND = No arsenic detected

4) Alliance Beach (mg/Kg)      5) Almond Beach (mg/Kg)      6) BA Beach (mg/Kg)  
 9) Union Lake Beach (mg/Kg)      10) South End Union Lake Beach (mg/Kg)      --- Site Clean-up Level (mg/Kg)

**Figure 4-3. Arsenic Concentrations (mg/Kg) in Surficial Sediment Samples Collected in the Vicinity of Vineland Chemical Superfund Site, 1992-2009**



\*Historical data from (USEPA/ERTC 1999) citation.

\*\*May 2006 data from (EA 2006a) and November 2006 data from (EA 2007)

Sample Year

ND = No arsenic detected

4) Alliance Beach

5) Almond Beach

6) BA Beach

9) Union Lake Beach

10) South End Union Lake Beach

--- Site Clean-up Level

**TABLE 4-1. COMPARISON OF ARSENIC RESULTS FOR SAMPLES COLLECTED IN VICINITY OF VINELAND  
CHEMICAL SUPERFUND SITE, MAY 2006 BASELINE SAMPLING, NOVEMBER 2006 PERIODIC SAMPLING,  
SEPTEMBER 2007 POST REMEDIAL ACTION SAMPLING, AND PERIODIC SAMPLING - SPRING 2009 & FALL  
2009**

**VINELAND PERIODIC SAMPLING - FALL 2009**

Sampling Station	Units	May 2006 Baseline Sampling	November 2006 Periodic Sampling	September 2007 Post Remedial Action Sampling	Periodic Sampling - Spring 2009 (May 2009)	Periodic Sampling - Fall 2009 (November 2009)
<b>Water Sample Results</b>						
1) MILL-WAT1	ug/L		U	U	-	-
1) MILL-WAT2	ug/L	U	U	U	-	-
2) R55-WAT1	ug/L		<b>8.8</b>		U	-
2) R55-WAT2	ug/L					-
3) BWB-WAT1	ug/L	U	U	U	U	U
3) BWB-WAT2	ug/L	U	U	U	U	U
4) ALLIANCE-WAT1	ug/L	U	U	U	U	U
4) ALLIANCE-WAT2	ug/L	U	U	U	<b>9.4</b>	U
5) ALMOND-WAT1	ug/L	U	U	U	U	U
5) ALMOND-WAT2	ug/L	U	U		U	U
6) BA-WAT1	ug/L	U	U		U	U
6) BA-WAT2	ug/L	U	U	U		U
7) SHERMAN-WAT1	ug/L	U	U		U	U
7) SHERMAN-WAT2	ug/L				U	
8) NUL-WAT1	ug/L	U	U	U	U	U
8) NUL-WAT2	ug/L	U	U		U	
9) ULB-WAT1	ug/L	U	U	U	U	<b>10</b>
9) ULB-WAT2	ug/L	U	U		U	<b>10.9</b>
10) SUL-WAT1	ug/L	U	U	U	U	<b>9.2</b>
10) SUL-WAT2	ug/L		U			
<b>Solid Sediment Results</b>						
1) MILL-SED	mg/Kg	<b>14</b>		<b>8.2</b>	-	-
2) R55-SED	mg/Kg					-
3) BWB-SED	mg/Kg	<b>0.78</b>		<b>1.5</b>	<b>1.2</b>	<b>1.1</b>
4) ALLIANCE-SED	mg/Kg	<b>1.9</b>	<b>1.3</b>	U	U	<b>0.79</b>
5) ALMOND-SED	mg/Kg	<b>2.5</b>	<b>1.4</b>	<b>1.3</b>	<b>1.5</b>	<b>0.94</b>
6) BA-SED	mg/Kg	<b>1.2</b>	<b>2.6</b>	<b>2.3</b>	<b>2.3</b>	U
7) SHERMAN-SED	mg/Kg	<b>12</b>	<b>7.3</b>		<b>3.3</b>	<b>1.8</b>
8) NUL-SED	mg/Kg					<b>14</b>
9) ULB-SED	mg/Kg					
10) SUL-SED	mg/Kg		<b>10</b>	<b>18</b>		
<b>Solid Shore Results</b>						
1) MILL-SHORE	mg/Kg				-	-
2) R55-SHORE	mg/Kg					-
3) BWB-SHORE	mg/Kg	U	<b>19</b>	<b>2</b>	<b>10</b>	
4) ALLIANCE-SHORE	mg/Kg	U	<b>1.5</b>	U	<b>1.2</b>	U
5) ALMOND-SHORE	mg/Kg	1	U	U	U	U
6) BA-SHORE	mg/Kg	<b>1.3</b>	<b>4.5</b>			
7) SHERMAN-SHORE	mg/Kg	<b>6.3</b>	U	<b>5.5</b>	<b>2.7</b>	<b>1.5</b>
8) NUL-SHORE	mg/Kg					
9) ULB-SHORE	mg/Kg	<b>2.4</b>	<b>8.1</b>	<b>2.1</b>	<b>1.7</b>	<b>5.2</b>
10) SUL-SHORE	mg/Kg	<b>1.4</b>	<b>2.1</b>	<b>6.5</b>	<b>2.3</b>	<b>1</b>
<b>Solid Beach Results</b>						
4) ALLIANCE-BEACH	mg/Kg	1	U	U	<b>1.2</b>	U
5) ALMOND-BEACH	mg/Kg	U	U	U	U	U
6) BA-BEACH	mg/Kg	U	U	U	U	U
9) ULB-BEACH	mg/Kg	<b>0.9</b>	<b>1.1</b>	<b>1</b>	U	<b>0.91</b>
10) SUL-BEACH	mg/Kg	U	U	U	U	U

**NOTES:**

U = undetected arsenic concentration

**Bold values represent detected arsenic concentrations; shaded and bolded values indicate arsenic exceedences as noted below:**

Site Clean-up Level for Solids = 20 ppm (mg/kg)

USEPA Drinking Water Criterion for Water = 10 ppb (ug/L)

"-" = no sample collected

**TABLE 4-2. ARSENIC CONCENTRATIONS (µG/L) IN WATER SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2009**

**VINELAND PERIODIC SAMPLING - FALL 2009**

Sample Location	Sampling Year											
	1992*	1994*	1995*	1996*	1997*	1998*	1999*	May 2006**	Nov 2006+	Sept 2007+	May 2009+	Nov 2009+
4 ) Alliance Beach (ug/L)	30	23	100	40	110	120	240	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND
5) Almond Beach (ug/L)	140	13	200	110	20	24	110	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND
6) BA Beach (ug/L)	16	13	77	125	21	23	11	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND
9) Union Lake Beach (ug/L)	NS	NS	NS	16	6.6	8.8	6	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND
10) South End Union Lake Beach (ug/L)	NS	NS	NS	NS	NS	26	20	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND
USEPA Drinking Water Criterion (ppb)	10	10	10	10	10	10	10	10	10	10	10	10

NOTE: Shaded and bold values represent detected arsenic concentrations equivalent to or above the USEPA Drinking Water Criterion of 10 ug/L (ppb) for arsenic

NS = no sample collected; ND = not detected; below analytical limit

\*Historical data from (USEPA/ERTC 1999) citation

\*\*May 2006 data from (EA 2006a) citation

+2006, 2007, and 2009 data are presented as WAT1/WAT2

**TABLE 4-3. ARSENIC CONCENTRATIONS (mg/Kg) IN BEACH (SOIL) SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2009**

**VINELAND PERIODIC SAMPLING - FALL 2009**

Sample Location	Sampling Year											
	1992*	1994*	1995*	1996*	1997*	1998*	1999*	May 2006**	Nov 2006	Sept 2007	May 2009	Nov 2009
4) Alliance Beach (mg/Kg)	NS	<i>0.45 ND</i>	2.2	0.89	0.49	1.1	0.59	1	ND	ND	1.2	ND
5) Almond Beach (mg/Kg)	NS	0.92	0.86	0.76	0.46	1	0.43	ND	ND	ND	ND	ND
6) BA Beach (mg/Kg)	NS	<i>0.44 ND</i>	4	0.67	0.81	<i>0.41 ND</i>	<i>0.47 ND</i>	ND	ND	ND	ND	ND
9) Union Lake Beach (mg/Kg)	NS	NS	NS	1.3	3.1	1.2	2.6	0.9	1.1	1	ND	0.91
10) South End Union Lake Beach (mg/Kg)	NS	NS	NS	NS	NS	2.3	<i>0.48 ND</i>	ND	ND	ND	ND	ND
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20	20	20	20	20	20

NOTE: Italics = arsenic undetected at indicated concentration (detection limit)

NS = No sample collected; ND = not detected; below analytical detection limit

No beach (soil) samples exceeded the Site Clean-up Level of 20 mg/Kg for solids

\*Historical data from (USEPA/ERTC 1999) citation

\*\*May 2006 data from (EA 2006a) citation



**TABLE 4-4. ARSENIC CONCENTRATIONS (mg/Kg) IN SURFICIAL SEDIMENT SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2009**

**VINELAND PERIODIC SAMPLING - FALL 2009**

Sample Location	Sampling Year						
	1992*	1994*	1995*	1996*	1997*	1998*	1999*
4) Alliance Beach (mg/Kg)	11.1	9.65	7.75	1.6	2.2	4.2	6.7
5) Almond Beach (mg/Kg)	7.9	2	3.85	5.3	4.35	17	2.7
6) BA Beach (mg/Kg)	11.8	19.3	5.95	10.5	3.25	2.5	4.2
9) Union Lake Beach (mg/Kg)	NS	NS	NS	5	2.65	2.5	4.4
10) South End Union Lake Beach (mg/Kg)	NS	NS	NS	NS	NS	17.5	8.1
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20

Sample Location	Sampling Year									
	May 2006-sed	May 2006-shore	Nov 2006-sed	Nov 2006-shore	Sept 2007-sed	Sept 2007-shore	May 2009-sed	May 2009-shore	Nov 2009-sed	Nov 2009-shore
4) Alliance Beach (mg/Kg)	1.9	ND	1.3	1.5	ND	ND	ND	1.2	0.79	ND
5) Almond Beach (mg/Kg)	2.5	1	1.4	ND	1.3	ND	1.5	ND	0.94	ND
6) BA Beach (mg/Kg)	1.2	1.3	2.6	4.5	2.3	2.3	2.3	1	ND	2.1
9) Union Lake Beach (mg/Kg)	1.9	2.4	3.5	8.1	3.4	2.1	1.1	1.7	1.1	5.2
10) South End Union Lake Beach (mg/Kg)	1.5	1.4	10	2.1	18	6.5	2.1	2.3	1.1	1
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20	20	20	20

NOTE: Shaded and bold values represent detected arsenic concentrations equivalent to or above the Site Clean-up Level of 20 mg/Kg (ppm) of arsenic for solids

NS = No sample collected; ND = not detected; below analytical detection limit

\*Historical data from (USEPA/ERTC 1999) citation



## 5. REFERENCES

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## **APPENDIX A**

### **ANALYTICAL RESULTS AND CHAIN- OF-CUSTODY (COC) FORMS FOR ARSENIC ANALYSES**

Client: EA Engineering Science, and Technology, Inc.				Project Manager: <b>Peggy Derrick</b>		Parameters/Method Numbers for Analysis								Chain of Custody Record						
15 Loveton Circle Sparks, MD 21152				Phone: 410-329-5126										Laboratory: <b>USEPA</b> <b>Region 2 Laboratory</b> <b>2890 Woodbridge Ave.</b> <b>Edison, NJ 08837</b>						
Project Name: Vineland Fall Monitoring				Field Contact:										Phone: 732-906-6886						
Project#: 62305.01				Todd Ward										ATTN: Mr. John Birri/John Bourbon						
Page 1 of 4																				
Date	Time	Water	Sediment	Sample Identification		No. of Containers	Arsenic EPA 200.7/6010B													Remarks
11/18/09	1245		X	BWB-Shore-111809		1	X													
11/18/09	1300		X	BWB-Sed-111809		1	X													
11/18/09	1240	X		BWB-Wat1-111809		1	X													
11/18/09	1241	X		BWB-Wat2-111809		1	X													
11/18/09	1241	X		BWB-Wat2-MS-111809		1	X													
11/18/09	1241	X		BWB-Wat2-MSD-111809		1	X													
11/18/09	1405		X	Alliance-Shore-111809		1	X													
11/18/09	1400		X	Alliance-Sed-111809		1	X													
11/18/09	1407		X	Alliance-Beach-111809		1	X													
11/18/09	1350	X		Alliance-Wat1-111809		1	X													
11/18/09	1351	X		Alliance-Wat2-111809		1	X													
11/18/09	1505		X	Almond-Shore-111809		1	X													
11/18/09	1510		X	Almond-Sed-111809		1	X													
11/18/09	1500		X	Almond-Beach-111809		1	X													
11/18/09	1455	X		Almond-Wat1-111809		1	X													
11/18/09	1456	X		Almond-Wat2-111809		1	X													
11/18/09	1555		X	BA-Shore-111809		1	X													
11/18/09	1550		X	BA-Sed-111809		1	X													
Sampled by: (Signature) <i>Todd Ward</i>				Date/Time 11/19/09 1100		Relinquished by: (Signature) <i>Todd Ward</i>				Date/Time 11/19/09 1700										
Relinquished by: (Signature)				Date/Time		Received by Laboratory: (Signature)				Date/Time										

[illegible]

[illegible]

[illegible]

**Case Narrative:**  
**Vineland Chemical #09110020**

The National Environmental Laboratory Accreditation Conference (NELAC) is a voluntary environmental laboratory accreditation association of State and Federal agencies. NELAC established and promoted a national accreditation program that provides a uniform set of standards for the generation of environmental data that are of known and defensible quality. The EPA Region 2 Laboratory is NELAC accredited. The Laboratory tests that are accredited have met all the requirements established under the NELAC Standards.

**Comment(s):**

- The contaminant concentrations for all sediment/soil samples are reported on a "dry-weight" basis.
- All field samples designated with a "MS" or "MSD" were treated as environmental samples and reported as such. A separate matrix spike sample is prepared, analyzed and evaluated for each batch of 20 samples; however, the results for this sample, and other QC samples associated with each batch, are not included in the Laboratory report.

**Data Qualifier(s):**

- U- The analyte was not detected at or above the Reporting Limit.
- J- The identification of the analyte is acceptable; the reported value is an estimate.
- K- The identification of the analyte is acceptable; the reported value may be biased high.
- L- The identification of the analyte is acceptable; the reported value may be biased low.
- NJ- There is presumptive evidence that the analyte is present; the analyte is reported as a tentative identification. The reported value is an estimate.

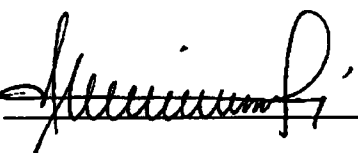
**Reporting Limit(s):**

The Laboratory was able to achieve the appropriate Reporting Limit for Arsenic as requested.

**Method(s):**

All methods that are NELAC accredited in the Laboratory are noted with "NELAC" at the end of the method reference.

- TAL Metals Analysis (As), EPA SOP C-109 (ICP/AES Method)

Approval:  Date: 12/16/09





U.S. Environmental Protection Agency  
Region 2 Laboratory  
2890 Woodbridge Avenue  
Edison, NJ 08837

**Data Report: VINELAND CHEMICAL**

**Project Number: 09110020**

**Program: Y206E**

**Project Leader: ERIKA MCCORMICK**

Remark Codes	Explanation
U	THE ANALYTE WAS NOT DETECTED AT OR ABOVE THE REPORTING LIMIT.
J	THE IDENTIFICATION OF THE ANALYTE IS ACCEPTABLE; THE REPORTED VALUE IS AN ESTIMATE.
UJ	THE ANALYTE WAS NOT DETECTED AT OR ABOVE THE REPORTING LIMIT. THE REPORTING LIMIT IS AN ESTIMATE.
N	THERE IS PRESUMPTIVE EVIDENCE THAT THE ANALYTE IS PRESENT; THE ANALYTE IS REPORTED AS A TENTATIVE IDENTIFICATION.
NJ	THERE IS PRESUMPTIVE EVIDENCE THAT THE ANALYTE IS PRESENT; THE ANALYTE IS REPORTED AS A TENTATIVE IDENTIFICATION. THE REPORTED VALUE IS AN ESTIMATE.
R	THE PRESENCE OR ABSENCE OF THE ANALYTE CANNOT BE DETERMINED FROM THE DATA DUE TO SEVERE QUALITY CONTROL PROBLEMS. THE DATA ARE REJECTED AND CONSIDERED UNUSABLE.
K	THE IDENTIFICATION OF THE ANALYTE IS ACCEPTABLE; THE REPORTED VALUE MAY BE BIASED HIGH. THE ACTUAL VALUE IS EXPECTED TO BE LESS THAN THE REPORTED VALUE.
L	THE IDENTIFICATION OF THE ANALYTE IS ACCEPTABLE; THE REPORTED VALUE MAY BE BIASED LOW. THE ACTUAL VALUE IS EXPECTED TO BE GREATER THAN THE REPORTED VALUE.
NV	NOT VALIDATED
INC	RESULT NOT ENTERED



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07039

Field/Station ID: BWB-WAT1-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

---

Remark  
Codes

8.0U

Units

ug/L

AL07040

Field/Station ID: BWB-WAT2-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

---

Remark  
Codes

8.0U

Units

ug/L

AL07041

Field/Station ID: BWB-WAT2-MS-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

---

Remark  
Codes

8.0U

Units

ug/L

AL07042

Field/Station ID: BWB-WAT2-MSD-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

---

Remark  
Codes

8.0U

Units

ug/L



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07043

Field/Station ID: ALLIANCE-WAT1-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

Remark  
Codes

Units

---

8.0U

ug/L

AL07044

Field/Station ID: ALLIANCE-WAT2-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

Remark  
Codes

Units

---

8.0U

ug/L

AL07045

Field/Station ID: ALMOND-WAT1-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

Remark  
Codes

Units

---

8.0U

ug/L

AL07046

Field/Station ID: ALMOND-WAT2-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

Remark  
Codes

Units

---

8.0U

ug/L



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07047

Field/Station ID: BA-WAT1-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	8.0U	ug/L

AL07048

Field/Station ID: BA-WAT2-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	8.0U	ug/L

AL07049

Field/Station ID: SHERMAN-WAT1-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	8.0U	ug/L

AL07050

Field/Station ID: SHERMAN-WAT2-111809

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	20		ug/L



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07051

Field/Station ID: NUL-WAT1-111909

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	—	8.0U	ug/L

AL07052

Field/Station ID: NUL-WAT2-111909

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	230		ug/L

AL07053

Field/Station ID: ULB-WAT1-111909

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	10		ug/L

AL07054

Field/Station ID: ULB-WAT2-111909

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	1,100		ug/L



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07055

Field/Station ID: SUL-WAT1-111909

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	9.2		ug/L

AL07056

Field/Station ID: SUL-WAT2-111909

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	19		ug/L

AL07057

Field/Station ID: DUP-7

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	—	8.0U	ug/L

AL07058

Field/Station ID: DUP-8

Date Received: 11/20/2009

Matrix: Aqueous

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	290		ug/L



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07059

Field/Station ID: PBLANK-01-111809  
Matrix: Aqueous

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	8.0U	ug/L

AL07060

Field/Station ID: PBLANK-02-111909  
Matrix: Aqueous

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	8.0U	ug/L

AL07061

Field/Station ID: BSBLANK-01-111809  
Matrix: Aqueous

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	8.0U	ug/L

AL07062

Field/Station ID: BSBLANK-02-111909  
Matrix: Aqueous

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	8.0U	ug/L



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

**AL07063** Field/Station ID: TTBLANK-111909  
Matrix: Aqueous

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

Remark  
Codes

Units

---

8.0U

ug/L

**AL07064** Field/Station ID: BWB-SHORE-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

Remark  
Codes

Units

2.1

mg/Kg

**AL07065** Field/Station ID: BWB-SED-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

Remark  
Codes

Units

1.1

mg/Kg

**AL07066** Field/Station ID: ALLIANCE-SHOR-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

Result

Remark  
Codes

Units

0.670

mg/Kg





U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07067

Field/Station ID: ALLIANCE-SED-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	0.79		mg/Kg

AL07068

Field/Station ID: ALLIANCE-BEAC-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	—	0.679	mg/Kg

AL07069

Field/Station ID: ALMOND-SHORE-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	0.68U	mg/Kg

AL07070

Field/Station ID: ALMOND-SED-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	0.94		mg/Kg



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

**AL07071** Field/Station ID: ALMOND-BEACH-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	0.65U	mg/Kg

**AL07072** Field/Station ID: BA-SHORE-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	280		mg/Kg

**AL07073** Field/Station ID: BA-SED-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	0.56U	mg/Kg

**AL07074** Field/Station ID: BA-BEACH-111809  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	0.59U	mg/Kg



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07075

Field/Station ID: BA-BEACH-MS-111809

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	0.58U	mg/Kg

AL07076

Field/Station ID: BA-BEACH-MSD-111809

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC		0.54U	mg/Kg

AL07077

Field/Station ID: SHERMAN-SHORE-111809

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	1.5		mg/Kg

AL07078

Field/Station ID: SHERMAN-SED-111809

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	1.8		mg/Kg



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07079

Field/Station ID: NUL-SHORE-111909

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	65		mg/Kg

AL07080

Field/Station ID: NUL-SED-111909

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	14		mg/Kg

AL07081

Field/Station ID: ULB-SHORE-111909

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	5.2		mg/Kg

AL07082

Field/Station ID: ULB-SED111909

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	3.0		mg/Kg



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07083

Field/Station ID: ULB-BEACH-111909  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

CAS Number	Analyte Name
7440-38-2	ARSENIC

Result
0.91

Remark Codes
--------------

Units
mg/Kg

AL07084

Field/Station ID: ULB-BEACH-MS-111909  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

CAS Number	Analyte Name
7440-38-2	ARSENIC

Result
0.96

Remark Codes
--------------

Units
mg/Kg

AL07085

Field/Station ID: ULB-BEACH-MSD-111909  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

CAS Number	Analyte Name
7440-38-2	ARSENIC

Result
1.2

Remark Codes
--------------

Units
mg/Kg

AL07086

Field/Station ID: SUL-SHORE-111909  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

CAS Number	Analyte Name
7440-38-2	ARSENIC

Result
1.0

Remark Codes
--------------

Units
mg/Kg



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07087

Field/Station ID: SUL-SED-111909  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	40		mg/Kg

AL07088

Field/Station ID: SUL-BEACH-111909  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	0.58		mg/Kg

AL07089

Field/Station ID: DUP-1  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	0.96		mg/Kg

AL07090

Field/Station ID: DUP-2  
Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	0.69		mg/Kg



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07091

Field/Station ID: DUP-3

Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

<u>Result</u>
21

<u>Remark Codes</u>
---------------------

<u>Units</u>
mg/Kg

AL07092

Field/Station ID: DUP-4

Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

<u>Result</u>
0.72U

<u>Remark Codes</u>
---------------------

<u>Units</u>
mg/Kg

AL07093

Field/Station ID: DUP-5

Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

<u>Result</u>
320

<u>Remark Codes</u>
---------------------

<u>Units</u>
mg/Kg

AL07094

Field/Station ID: DUP-6

Matrix: Sediment

Date Received: 11/20/2009

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>
7440-38-2	ARSENIC

<u>Result</u>
0.90

<u>Remark Codes</u>
---------------------

<u>Units</u>
mg/Kg



U.S. EPA Region 2 Laboratory  
Data Report

Survey Name: VINELAND CHEMICAL

Project Number: 09110020

\*Sorted By Sample ID

AL07095

Field/Station ID: DUP-9

Date Received: 11/20/2009

Matrix: Sediment

Sample Description:

Single Component Analyses

<u>CAS Number</u>	<u>Analyte Name</u>	<u>Result</u>	<u>Remark Codes</u>	<u>Units</u>
7440-38-2	ARSENIC	---	0.61U	mg/Kg

Project Approval: \_\_\_\_\_

Date: \_\_\_\_\_

Refer to Page 1 for an explanation of Remark Codes

Report Date: 12/11/2009 3:30PM



## **APPENDIX B**

### **FIELD DOCUMENTATION AND LOGBOOK**

18 Nov 2009

Vineyard Fall Monitoring  
Sed. / Water Sample

Sample dates and times on sample  
log sheet

1320 - wat. qual. @ BNB Confluence

Temp = 10.06 °C pH = 7.51  
Cond = 0.171  $\mu$ S/cm Turb = 8.9 NTU  
Sal = 0.11 ppt  
DO = 10.54 mg/L

1401 - wat. qual. @ Alliance Beach

Temp = 10.23 °C pH = 7.49  
Cond = 0.175  $\mu$ S/cm Turb = 9.5 NTU  
Sal = 0.12 ppt  
DO = 10.66 mg/L

1515 - wat. qual. @ Almond Beach

Temp = 10.26 °C pH = 7.05  
Cond = 0.171  $\mu$ S/cm Turb = 9.0 NTU  
Sal = 0.11 ppt  
DO = 10.55 mg/L

18 Nov. 2009 Vineland Fall  
Vineland Rd./Water Monitoring

1613 - wat. qual. @ "BA" Reach  
Temp. = 10.46°C pH = 7.02  
Cond. = 0.170  $\mu$ S/cm Turb. = 9.3 NTU  
Sal. = 0.11 ppt  
DO = 10.84 mg/L

1702 - wat. qual. @ Sherman  
Temp. = 11.19°C pH = 7.16  
Cond. = 0.197  $\mu$ S/cm Turb. = 11.3 NTU  
Sal. = 0.13 ppt  
DO = 10.61 mg/L

19 Nov. 2009

0834 - wat. qual. @ NUL (north end of  
Union Lake)

Temp. 11.07 pH = 7.62  
Cond. 0.190 Turb. 10.2  
Sal. 0.12  
DO = 10.29

19 Nov. 2009

0918 - wat. qual. @ ULB (Union Lake Beach)  
Temp. = 11.05 pH = 7.49  
Cond. = 0.179 Turb. = 9.2  
Sal. = 0.12  
DO = 10.93

0955 - wat. qual. @ SUL (south end of  
Union Lake Beach)  
Temp. = 11.08 pH = 7.38  
Cond. = 0.179 Turb. = 9.2  
Sal. = 0.12  
DO = 10.93

**Vineland Field Sediment And Water Sample Log**  
**November 2009**

Sample Location	Easting (ft)	Northing (ft)	Latitude	Longitude	Sample IDs	Date	Time
1) West of Mill Rd	334024.4	247694	39 30 43.52842	75 03 37.45102	Mill-Shore-	*	*
					Mill-Shore-MS-	*	*
					Mill-Shore-MSD-	*	*
	334015.2	247695.9	39 30 43.54664	75 03 37.56857	Mill-Sed-	*	*
	334015.2	247695.9	39 30 43.54664	75 03 37.56857	Mill-Wat1-	*	*
					Mill-Wat2-	*	*
2) West of Rte 55	331366.9	246758.9	39 30 34.12137	75 04 11.28513	R55-Shore-	*	*
	331364.9	246771.1	39 30 34.24182	75 04 11.31164	R55-Sed-	*	*
					R55-Sed-MS-	*	*
					R55-Sed-MSD-	*	*
	331364.9	246771.1	39 30 34.24182	75 04 11.31164	R55-Wat1-	*	*
					R55-Wat2-	*	*
3) BWB & Maurice Confluence	329121.5	244869.7	39 30 15.30774	75 04 39.78062	BWB-Shore- 11/18/09	11/18/09	1245
					DUP-3 ↗		
	329115.3	244861.3	39 30 15.22432	75 04 39.85903	BWB-Sed- 11/18/09	11/18/09	1300
					DUP-1 ↗		
	329115.3	244861.3	39 30 15.22432	75 04 39.85903	BWB-Wat1- 11/18/09		1240
					BWB-Wat2- 11/18/09		1241
					BWB-Wat2-MS- 11/18/09		1241
4) Alliance Beach					BWB-Wat2-MSD- 11/18/09	↓	1241
	328576.3	243944.7	39 30 06.13072	75 04 46.66060	Alliance-Shore- 11/18/09	11/18/09	1405
	328591.8	243933.9	39 30 06.02496	75 04 46.46197	Alliance-Sed-		1400
	328559.4	243958.3	39 30 06.26406	75 04 46.87733	Alliance-Beach-		1407
					DUP-2 ↗		
	328591.8	243933.9	39 30 06.02496	75 04 46.46197	Alliance-Wat1-		1350
					Alliance-Wat2- ↓	↓	1351

**Vineland Field Sediment And Water Sample Log**  
**November 2009**

Sample Location	Easting (ft)	Northing (ft)	Latitude	Longitude	Sample IDs	Date	Time
5) Almond Beach	329541.1	241835.2	39 29 45.34227	75 04 34.17950	Almond-Shore- 111809 DUP-4 →	11/18/09	1505
	329514.7	241839.9	39 29 45.38706	75 04 34.51667	Almond-Sed-		1510
	329514.7	241839.9	39 29 45.38706	75 04 34.51667	Almond-Wat1-		1455
					Almond-Wat2-		1456
	329555.6	241842.1	39 29 45.41138	75 04 33.99508	Almond-Beach- ↓	↓	1500
6) "BareA" Beach	330364.3	237993.7	39 29 07.42593	75 04 23.36617	BA-Shore- 111809 DUP-5 →	11/18/09	1535
	330353.4	237991.9	39 29 07.40745	75 04 23.50505	BA-Sed-		1550
	330353.4	237991.9	39 29 07.40745	75 04 23.50505	BA-Wat1-		1545
					BA-Wat2-		1546
	330398.3	238011.7	39 29 07.60597	75 04 22.93395	BA-Beach-		1600
					BA-Beach-MS-		1600
					BA-Beach-MSD- ↓		1600
7) Sherman Ave.	330560.5	224383.2	39 26 52.91552	75 04 19.76166	Sherman-Shore- 111809	11/18/09	1650
	330557.8	224385.6	39 26 52.93908	75 04 19.79627	Sherman-Sed-		1655
					DUP-6 →		
	330557.8	224385.6	39 26 52.93908	75 04 19.79627	Sherman-Wat1-		1640
					Sherman-Wat2- ↓	↓	1641
8) North End of Union Lake	331330.7	219656.9	39 26 06.24993	75 04 09.56259	NUL-Shore- 111909	11/19/09	0825
	331300.6	219602.9	39 26 05.71433	75 04 09.94189	NUL-Sed-		0820
	331300.6	219602.9	39 26 05.71433	75 04 09.94189	NUL-Wat1-		0815
					DUP-7 →		
					NUL-Wat2- ↓	↓	0816

**Vineland Field Sediment And Water Sample Log**  
November 2009

Sample Location	Easting (ft)	Northing (ft)	Latitude	Longitude	Sample IDs	Date	Time
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Sample Location	Easting (ft)	Northing (ft)	Latitude	Longitude	Sample IDs	Date	Time
9) Union Lake Beach	335338.3	210331.3	39 24 34.32399	75 03 17.75094	ULB-Shore- 111909	11/19/09	0920
	335138	210478.8	39 24 35.76968	75 03 20.31459	ULB-Sed-		0910
	335138	210478.8	39 24 35.76968	75 03 20.31459	ULB-Wat1-		0900
					ULB-Wat2-		0901
					DUP-8 →		
	335386.4	210342	39 24 34.43267	75 03 17.13892	ULB-Beach-		0925
					ULB-Beach-MS-		0925
					ULB-Beach-MSI)- ↓	↓	0925

10) South End Union Lake Beach	336536.7	208756	39 24 18.82646	75 03 02.35932	SUL-Shore- 111909	11/19/09	0955
	336364.9	208736	39 24 18.61842	75 03 04.54658	SUL-Sed-		0950
	336364.9	208736	39 24 18.61842	75 03 04.54658	SUL-Wat1-		0940
					SUL-Wat2-		0941
	336558.2	208757.3	39 24 18.84061	75 03 02.08550	SUL-Beach-		1200
					DUP-9 → ↓		

Target coordinates in New Jersey State Plane NAD83

\* - samples not collected due to excavation of location for clean-up activities by USACE

PBlank-01- 111809 1730

PBlank-02- 111909 1035

BSBlank-01- 111809 1735

BSBlank-02- 111909 1040

TTBlank- 111909 1045

<u>Sed.</u>	<u>Water</u>
10	8
12	6
10	8
<u>32</u>	<u>3</u>
	25

## **APPENDIX C**

**USEPA REGION 2 DESA - STANDARD  
OPERATING PROCEDURES C-109 AND  
C-116**



## STANDARD OPERATING PROCEDURE

### PREPARATION OF AQUEOUS, TCLP EXTRACTS, SOIL/SEDIMENT/SLUDGE/SOLID, WASTE OIL/ORGANIC SOLVENTS, AND BIOLOGICAL TISSUE MATRICES BY BLOCK DIGESTION

#### Signature and Title

Prepared by:	_____	_____
	Renee Lettieri, Chemist, OICS	Date
Peer Reviewed by:	_____	_____
	Linda Boyer, Env. Protection Specialist, OICS	Date
QA Reviewed by:	_____	_____
	Sumy P. Cherukara, Quality Assurance Officer	Date
Approved by:	_____	_____
	John R. Bourbon, Chief, OICS	Date
Approved by:	_____	_____
	Deborah A. Szaro, Chief, Laboratory Branch	Date

#### Annual Review

Reviewed by:	_____	_____
	Signature	Date
Reviewed by:	_____	_____
	Signature	Date



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## **STANDARD OPERATING PROCEDURE**

### **PREPARATION OF AQUEOUS, TCLP EXTRACTS, SOIL/SEDIMENT/SLUDGE, WASTE OIL/ORGANIC SOLVENTS, AND BIOLOGICAL TISSUE MATRICES BY BLOCK DIGESTION**

#### **1. Scope and Application**

- 1.1 This method is used to digest by DigiBLOC, all environmental samples, with the exception of drinking water. These include aqueous, TCLP extracts, soil/sediment/sludge/solid, waste oil/organic solvent, and biological tissue. Samples are then analyzed using ICP-AES, SOP #C109 or ICP-MS, SOP # C-112.
- 1.2 This SOP is based on EPA Methods 200.2, Revision 8.8 and EPA Method 200.8, Revision 5.4.

#### **2. Summary of Method**

- 2.1 Aqueous or Aqueous TCLP: A suitable aliquot (usually 50 mL) of a well mixed, aqueous or homogeneous extract sample is accurately measured into a DigiTUBE and heated on the DigiBLOC at 85° C with HNO<sub>3</sub> and HCL until the volume is reduced to 20mL. A watch glass is then placed on the tube and the sample is gently refluxed for an additional 30 minutes. After cooling, the sample is brought up to a known volume, capped and mixed. If needed, the digestates may be filtered.
- 2.2 Soil/Sediment/Sludge/Solid: Samples may be dried for a minimum of 12 hours at 60°C, ground well and mixed thoroughly or the drying step may be eliminated by digesting the samples as they are received. A correction factor derived from a Percent Solids determination is applied to the final result for either method. An aliquot is accurately weighed into a DigiTUBE and digested with HNO<sub>3</sub> and HCL at 95° C for 30 minutes. After cooling, the sample is filtered and brought up to a known volume, capped and mixed.
- 2.3 For biological tissue digestion, the sample is accurately weighed into a DigiTUBE and digested with HNO<sub>3</sub> and 30% H<sub>2</sub>O<sub>2</sub>.
- 2.4 Samples are then analyzed using ICP-AES or ICP-MS. In all instances, great care must be exercised to avoid contamination.

### **3. Definitions**

See SOP#G-15 for definitions.

### **4. Interferences**

Samples must be well mixed and as homogenous as possible. Soil/Sediments/Sludges/Solids must be reduced to as small a particle size as practicable.

### **5. Safety**

5.1 The toxicity or carcinogenicity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be kept to an absolute minimum by following the appropriate standard safety procedures, e.g. wear proper protective equipment, gloves, lab coat, and working inside hoods whenever possible. Refer to Edison Facility Safety Manual Region II, Part 2 - Laboratory Safety for specific guidelines.

#### **5.2 Safety guidelines for the DigiBLOC**

5.2.1 The DigiBLOC must be grounded and have a clearance of 3 inches on all sides. It must be located in an operable fume hood if the DigiVAC is not available. Do not mount DigiBLOC on a surface of flammable material.

5.2.2 The DigiBLOC must be lifted only from the bottom, not by the top white trim. Acquire assistance to move the unit.

5.2.3 Use caution when working around the instrument during operation. The unit has exposed hot surfaces.

### **6. Apparatus and Materials**

6.1 DigiBLOC Digestion System consisting of the Hot Block, with two 24 Position Racks with front and back airfoils,

6.2 DigiPROBE Sample Temperature Controller and probe.

6.3 DigiSET Sample Volume Controller and volume probe.

6.4 DigiVAC Exhaust System

- 6.5 50 mL DigiTUBEs, screw caps and disposable ribbed watch glasses.
- 6.6 Top loading balance capable of measuring 0.01 gram, disposable spatulas and small weighing dishes for soil/sediment/sludge/solid digestion.
- 6.7 Porcelain evaporating dishes (195mL), pestles and glass stirring rods for soil/sediment/sludge/solid digestion.
- 6.8 Two re-pipettes capable of dispensing 0.25-5.0mL.
- 6.9 Two automatic pipettes (1-250uL & 1-1000uL).
- 6.10 Whatman #41 filter paper - 125mm.
- 6.11 Disposable polypropylene funnels (65mm) and 100mL disposable beakers.
- 6.12 Filtration rack

## **7. Reagents and Solutions**

All reagents must be of high purity and suitable for trace metal analysis.

- 7.1 Concentrated Nitric Acid (HNO<sub>3</sub>)
- 7.2 Ultrex Concentrated Nitric Acid (HNO<sub>3</sub>)
- 7.3 Concentrated Hydrochloric Acid (37%)
- 7.4 Hydrogen Peroxide, 30%
- 7.5 Reagent Grade Water
- 7.6 SPEX CertiPrep Custom Claritas Standard High Check containing 250ug/mL (250ppm) of each of the following: Ag, Al, As, B, Ba Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Se, Sb, Si, Sr, Ti, Tl, V, Zn, Sn or equivalent.
- 7.7 SPEX CertiPrep Custom Multi-element Standard ICV II containing 250mg/l (250 ppm) of each of the following: Al, Ca, Fe, Mg, K, Na, Si or equivalent.
- 7.8 Soil LCS - Environmental Resource Associates: Trace Metals in Soil or equivalent.

- 7.9 Biological Tissue LCS - DOLT-3 National Research Council, Canada, Tort-2 National Research Council, Canada, NIST 15666 - Oyster Tissue or other suitable material.

## **8. Sample Collection, Preservation, Storage and Holding Time**

- 8.1 Aqueous: Samples may be collected in plastic or glass. Samples must be preserved to a pH<2 using HNO<sub>3</sub>, may be stored at room temperature and should be digested and analyzed within 6 months of collection.
- 8.2 Soil/Sediment/Sludge/Solid: Samples may be collected in plastic or glass. Samples must be stored at 4° C and should be digested and analyzed within 6 months of collection unless stored at -20° C after air-drying.
- 8.3 Biological Tissue: Samples may be collected in plastic or glass containers and must be stored at -20°C.
- 8.4 Waste Oil/Organic Solvents: Samples do not require any preservation and are stored at room temperature.
- 8.5 Drum sample usually have no temperature or holding time requirements.

## **9. Sample Preparation**

### **9.1 Aqueous Sample Preparation**

- 9.1.1 Verify that the pH of the sample is <2 using pH test paper. Record in the Metals Sample pH log book. If the pH is >2, add concentrated HNO<sub>3</sub> until the pH is <2, then wait at least 16 hours before rechecking the pH and proceeding with the sample prep.
- 9.1.2 Transfer 50mL (or other suitable aliquot) from a well-mixed, acid preserved sample to a 50mL DigiTUBE. In addition, prepare a Prep Blank, two LCS's and 1 matrix spike for each project/matrix with at least one matrix spike per batch of 20 or fewer samples. Also prepare extra blank sample tubes that will hold the DigiPROBE and, if used, the DigiSET volume control probe. Refer to Section 14.1 of this SOP for QC procedure.
- 9.1.3 Add 0.5 mL concentrated nitric acid and 0.25mL of concentrated hydrochloric acid to each tube.

- 9.1.4 Insert the tubes into the DigiBLOC for solution evaporation at a pre-tuned temperature of 85 °C. If space permits, leave the outer rows empty. Position the extra blank samples under the exhaust hole of the DigiVAC. Carefully position the DigiPROBE in one tube and the DigiSET volume control set to 20mL in the other tube. If the DigiVAC is unavailable, carefully place the instrument in a hood and proceed. If the DigiSET is not used, monitor volume visually.
- 9.1.5 Close the DigiVAC lid and turn power on to the DigiVAC, DigiSET and DigiBLOC.
- 9.1.6 Reduce volume to approximately 20 mL by gently heating at 85°C then cap each tube with a disposable ribbed watch glass and reflux for 30 minutes.
- 9.1.7 Remove from DigiBLOC. Allow to cool. Filter, if necessary. (See Section 9.2.7) Dilute to 50 mL with Reagent Grade water, cap and mix well.

## 9.2 Soil/ Sediment/Sludge/Solid Preparation

### 9.2.1 Sample Drying

#### 9.2.1.2 Pre-Drying Method

This method works best for samples that have a high water content. Evaporating dishes and pestles must be rinsed with 10% HNO<sub>3</sub>.

Transfer the sample to a 195mL porcelain evaporating dish using a glass stirring rod or disposable spatula and dry at 60°C for a minimum of 12 hours. Cool, then grind with a pestle in the porcelain evaporating dish. Mix well, transfer to a plastic or glass container and store at 4°C until ready to digest.

These sediment samples require a % Solids determination. See the METALS % SOLIDS LOGBOOK for procedure. % Solids results are reported under SOLA in LIMS. This does not preclude an analysis request for % Solids.

#### 9.2.1.2 "As Received" Method

This method works best for samples that have a low water content. Samples are digested as received. A % Solids determination is performed using the procedure described in the METALS % SOLIDS LOGBOOK. % Solids results are reported under SOLA in LIMS. This does not preclude an analysis request



for % Solids.

- 9.2.2 Weigh 0.5g or other suitable aliquot of well mixed sample into a 50 mL DigiTUBE. Use approximately 5mL of Reagent Grade water to rinse down the sides of the DigiTUBE. In addition, prepare a Prep Blank, two LCS's, 1 matrix spike for each project/matrix with at least one matrix spike per batch of 20 or fewer samples and an extra sample that will hold the DigiPROBE. Refer to Section 14.2 for QC prep.
- 9.2.3 Under a fume hood, add 5 mL Reagent Grade water, 1.0mL conc.  $\text{HNO}_3$  and 1.0mL of conc. HCL to the tubes. Keep samples under the hood until any reaction subsides.
- 9.2.4 Insert the tubes into the DigiBLOC for digestion at a pre-tuned temperature of 95°C. If space permits, leave the outer rows empty. In the extra sample tube, using a disposable watch glass with a hole, carefully position the DigiPROBE. This digestion may also be carried out using the DigiVAC.
- 9.2.5 Place a disposable watch glass on each tube and turn on the power to the DigiBLOC. If being used, close the DigiVAC lid and turn the power on to the DigiVAC
- 9.2.6 Heat samples at 95°C for 30 minutes. The DigiBLOC takes about 30 minutes to heat up to temperature.
- 9.2.7 Filtration is required for soil/ sediment/sludge/solid samples. Label a duplicate set of DigiTUBEs. Rinse Whatman #41 filter paper in disposable funnels with approximately 10mL Reagent Grade water. Place rinsed funnels into duplicate DigiTUBEs and transfer corresponding sample. Rinse original tube several times with Reagent Grade water. Dilute to 50mL with Reagent Grade water, cap and mix well.

### 9.3 Biological Tissue Digestion

- 9.3.1 Homogenize the samples. Store samples in the freezer if digestion is delayed, then defrost prior to preparation for digestion. All determinations, including the LCS and matrix spike must be done in triplicate. Refer to Section 14.3 of this SOP for QC prep.
- 9.3.2 Weigh 2.0 g finely ground and well mixed sample or 1.0 g LCS ( Dolt-3, Tort-2 or NIST 15666 Oyster Tissue) into a 50 mL DigiBLOC tube. Record actual weights

in Prep Book. Be careful not to let tissue stick to sides of tube - aim for the bottom of tube. Prepare three tubes for the Prep Blanks and weigh an additional tissue sample for the DigiPROBE.

- 9.3.3 Add 5 mL concentrated Ultrex  $\text{HNO}_3$  and swirl to mix. Heat gently in the DigiBLOC (tuned to  $95^\circ\text{C}$ ) with continued swirling. If samples begin to foam, remove from heat until foam subsides. Continue to heat/cool and swirl until samples no longer foam, then digest at  $95^\circ\text{C}$  until sample appears clear. A 2 g sample should be clear after about 15 minutes of digestion.
- 9.3.4 Foaming is a more serious problem with the LCS. Dolt -3 will foam copiously when warmed with  $\text{HNO}_3$ . Extreme care is needed in swirling and gently heating until the LCS/ $\text{HNO}_3$  mixture appears clear. Then allow to digest at  $95^\circ\text{C}$  in the DigiBLOC for an additional 15 minutes.
- 9.4.5 After digestion with  $\text{HNO}_3$  is completed, add 0.5 mL 30%  $\text{H}_2\text{O}_2$  in 0.1 mL portions to each of the tubes, swirling and heating with each addition until any effervescence subsides. It then should be safe to add 0.5 mL portions of the  $\text{H}_2\text{O}_2$ , heating in between additions until the samples become totally clear. After samples are totally clear, add 1 mL additional  $\text{H}_2\text{O}_2$ , cover the tubes with a plastic watch glass and digest for 30 minutes more. Remove from the DigiBLOC, cool and dilute to 20 mL with Reagent Grade water. Cap securely and mix well.

## **10. Instrument Operating Conditions**

### **10.1 DigiBLOC set-up**

#### **10.1.1 Power ON - Power switch.**

#### **10.1.2 Check Temperature Set-Point by pressing the star button (\*). Temperature should be set at $85^\circ\text{C}$ for Aqueous and TCLP extracts, $95^\circ\text{C}$ for soil/sediment/sludge/solid, waste oil/organic solvent and biological tissue. If the temperature must be changed or the DigiPROBE is either connected or disconnected, the instrument must be tuned.**

##### **10.1.2.1 Set temperature by pressing and holding the star button (\*) while simultaneously pressing the $\blacktriangle$ (arrow up) or the $\blacktriangledown$ (arrow down) button to obtain the desired temperature.**

##### **10.1.2.2 Tune DigiBLOC as follows:**

- Set desired temperature.
- Hold the ▲(arrow up) and ▼(arrow down) keys simultaneously for ≈ 3 seconds to enter program mode. The display will show *tunE*.
- While holding the star button(\*), hit the ▲(arrow up) to reach *AESP* (*the E is actually an upside down F*) and then release the star button (\*).
- Press and hold buttons simultaneously for 3 seconds until the temperature appears. The system will flash between *tunE*, *AESP* and the current temperature.
- When tuning is complete, the system will automatically turn *tunE* off and display the current temperature only.

## 10.2 DigiBLOC Shut-down

10.2.1 Power OFF - DigiBLOC and DigiVAC if used

10.2.2 Rinse DigiPROBE with Reagent Grade water and place in a clean empty tube.

## 11. Sample Analysis

Actual sample analysis is carried out using methods SOP #C-109 Trace Metals in Aqueous, Soil/Sediment/Sludge/Solid, Waste Oil, Organic Solvent, Biological Tissue- ICP-AES or SOP #C-112 Trace Elements in Aqueous, Soil/Sediment/Sludge/Solid, Waste Oil, Organic Solvent and Biological Tissue by ICP-MS.

## 12. Data Analysis and Calculations

Calculations are not done as part of this method. All weights and dilutions are recorded in the Metals Sample Prep Log Book

## 13. Method Performance

Method performance is evaluated as part of methods SOP #C-109 Trace Metals in Aqueous, Soil/Sediment/Sludge/Solid, Waste Oil, Organic Solvent, Tissue - ICP-AES or SOP #C-112 Trace Elements in Aqueous, Soil/Sediment/Sludge/Solid, Waste Oil, Organic Solvent and Biological Tissue by ICP-MS.

## 14. Quality Control

### 14.1 Aqueous Quality Control

- 14.1.1 One Prep Blank (PB) should be prepared for every batch of 20 or fewer samples. The PB is prepared by transferring 50mL of Reagent Grade water into a 50mL DigiTUBE and adding 0.5mL  $\text{HNO}_3$  and 0.25mL HCl.
- 14.1.2 Two LCS's ( Laboratory Control Samples) are prepared for every batch of 20 or fewer samples. These LCS's are made by pipetting 20uL of (CAL I) SPEX CertiPrep Custom Claritas Standard (250PPM) and 400uL of SPEX CertiPrep Custom Multi-element Standard ICV II (250PPM) into 50mL DigiTUBEs containing 50 mL Reagent Grade water, 0.5mL of concentrated  $\text{HNO}_3$  and 0.25mL concentrated HCl.
- 14.1.3 One Matrix Spike (MS) is prepared for each matrix per project with at least one MS per batch of 20 or fewer samples. The MS is prepared by adding 20uL of (CAL I) SPEX CertiPrep Custom Claritas Standard (250PPM) and 400uL of SPEX CERTIPREP Custom Multi-element Standard ICV II (250PPM) to a DigiTUBE containing 50 mL of a duplicate environmental sample, 0.5mL of concentrated  $\text{HNO}_3$  and 0.25mL concentrated HCl.

### 14.2 Sediment Quality Control

- 14.2.1 One Prep Blank should be prepared for every batch of 20 or fewer samples. The PB is prepared by transferring 5mL of Reagent Grade water into a 50mL DigiTUBE and adding 1.0mL  $\text{HNO}_3$  and 1.0mL HCl.
- 14.2.2 Two LCS's are prepared for every batch of 20 or fewer samples. These LCS's are made by weighing 0.5g of ERA's Trace Metals in Soil into a 50mL DigiTUBEs and adding 5mL of Reagent Grade water to wash down the sides of the tube, 1.0mL  $\text{HNO}_3$  and 1.0mL HCl.
- 14.2.3 One Matrix Spike is prepared for each matrix per project with at least one MS per batch of 20 or fewer samples. The MS is prepared by adding 20uL of (CAL I) SPEX CertiPrep Custom Claritas Standard (250PPM) and 400uL of SPEX CERTIPREP Custom Multi-element Standard ICV II (250PPM) to a 50mL DigiTUBE containing 0.5g of a duplicate environmental sample, 5mL of Reagent Grade water, 1.0mL  $\text{HNO}_3$  and 1.0mL HCl.

### 14.3 Biological Tissue Quality Control

- 14.3.1 Three Prep Blanks are prepared for every batch of 20 or fewer samples. The PB is prepared by transferring 5mL of conc.  $\text{HNO}_3$  and 5 mL 30%  $\text{H}_2\text{O}_2$  into a 50mL DigiTUBE and digesting at 95°C for about 45 minutes, then diluting to 20mL with Reagent Grade water.
- 14.3.2 The LCS is prepared in triplicate for every batch of 20 or fewer samples. DOLT-3 is presently being used for the LCS, but Tort-2, NIST 15666 Oyster Tissue or other suitable material are also acceptable. Digest as directed in 7.4.
- 14.3.3 The Matrix Spike (MS) is prepared in triplicate for each matrix per project for each batch of 20 or fewer samples. The MS is prepared by adding 20uL of (CAL I) SPEX CertiPrep Custom Claritas Standard (250PPM) and 400uL of SPEX CertiPrep Custom Multi-element Standard ICV II (250PPM) to a DigiTUBE containing 2.0g of a duplicate biological tissue sample and digesting as directed in 7.4.

## 15. Reporting and Validation

Copies of all Log Book entries (pH, Sample Preparation, Percent Solids) are included in the final data packages.

## 16. Pollution Prevention

- 16.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The USEPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the USEPA recommends recycling as the next best option.
- 16.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.
- 16.3 For information about pollution prevention that may be applicable to laboratories, consult *"Less is Better: Laboratory Chemical Management for Waste Reduction"*, available from the American Chemical Society's Department of Government

Regulations and Science Policy, 115 16<sup>th</sup> Street N.W., Washington D.C 20036,  
(202)872-4477.

## **17. Waste Management**

The USEPA requires that laboratory waste management practice be conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes should be characterized and disposed of in an acceptable manner. The agency urges laboratories to protect the air, water and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any water discharge permit and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management consult the Region 2 SOP #G-6, "Disposal of Samples and Hazardous Wastes".

## **18. References**

1. EPA Method 200.2, Revision 2.8.
2. SW846 3010A
3. Operation Manual for DigiBLOC 3000 Digestion System
4. DigiVAC Operation Manual





**STANDARD OPERATING PROCEDURE**

**DETERMINATION OF METALS IN AQUEOUS, TCLP EXTRACTS,  
SOIL/SEDIMENT, SLUDGE, WASTE OIL/ORGANIC SOLVENTS, AND  
BIOLOGICAL TISSUE SAMPLES BY TRACE (AXIAL CONFIGURATION)  
INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY**

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Signature Date

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
REGION 2  
DIVISION OF ENVIRONMENTAL SCIENCE AND ASSESSMENT  
LABORATORY BRANCH**

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**Appendix A : Data Work-Up**

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**Table 1: Standard Solutions Preparation**

**Table 2: Reporting Limits**

**DETERMINATION OF METALS IN AQUEOUS, TCLP EXTRACT, SOIL/SEDIMENT,  
SLUDGE, WASTE OIL/ORGANIC SOLVENTS, AND BIOLOGICAL TISSUE  
MATRICES BY TRACE (AXIAL CONFIGURATION)  
INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY**

## **1. Scope and Application**

- 1.1 This SOP is applicable to the preparation of environmental samples, including aqueous, TCLP extract, soil/sediment, biological tissue, and waste oil/organic solvents, for the determination of the following metals:

Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cu, Cr, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Se, Sb, Si, Sn, Sr, Ti, Tl, V, and Zn

Note - This SOP is not applicable to the preparation and analysis of drinking water compliance monitoring samples. The procedure for the preparation and analysis of drinking water compliance monitoring samples using the Trace ICAP is detailed in Laboratory SOP DW-5.

- 1.2 All analysts must satisfactorily perform an initial demonstration of capability (DOC) by meeting the method performance criteria in Sec. 13.1 prior to performing sample analysis using this SOP.
- 1.3 The standard reporting limits for both aqueous and non-aqueous samples are listed in Table 2.
- 1.4 This SOP is based on EPA Method 200.7, Revision 4.4.

## **2. Summary of SOP**

- 2.1 Environmental samples, e.g., aqueous, TCLP extracts, soil/sediment, sludges, waste oil/organic solvent, and biological tissue, are digested in a mixture of acids, according to the procedures described in U. S. Environmental Protection Agency, Region 2, SOP C-116 *"Preparation of Aqueous, TCLP Extracts, Soil/Sediment/Sludge, Waste Oil/Organic Solvents, and Biological Tissue Matrices by Block Digestion."*

- 2.2 The analysis described in this method involves multi-element determinations by ICAP-AES using a simultaneous Thermo-Jarrell Ash Trace Purge ICAP. The instrument measures characteristic atomic-line emission spectra by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element specific emission spectra are produced by a radio-frequency inductively coupled argon plasma. The spectra are dispersed by a grating spectrometer, and the intensities of the line spectra are monitored at specific wavelengths by a photomultiplier tube (PMT). Photocurrents from the pmt are processed and controlled by a computer system. A background correction technique is required to compensate for background contribution to the determination of the analytes. Background must be measured adjacent to the analyte wavelength during analysis. Various interferences must be considered and addressed appropriately.

### **3. Definitions**

See SOP G-15 for definitions.

### **4. Interferences**

- 4.1 Several types of interference effects may contribute to inaccuracies in the determination of trace elements. They can be summarized as follows:
- 4.1.1 Spectral Interferences - these interferences can be categorized as 1) overlap of a spectral line from another element; 2) unresolved overlap of molecular band spectra; 3) background contribution from continuous or recombination phenomena; and 4) background contribution from stray light from the line emission of high concentration elements. The first of these effects can be compensated for by utilizing a computer correction of the raw data, requiring the monitoring and measurement of the interfering element. The second effect may require selection of an alternate wavelength. The third and fourth effects can usually be compensated for by a background correction adjacent to the analyte line. In addition, users of simultaneous multi element instrumentation must assume the responsibility of verifying the absence of spectral interference from an element that could occur in a sample but for which there is no channel in the instrument array. For this purpose, linear relations between concentration and intensity for the analytes and the interferences must be demonstrated over the range of interest.
- 4.1.2 Physical Interferences - these interferences are generally considered to be effects associated with the sample nebulization and transport processes. Such properties

as change in viscosity and surface tension can cause significant inaccuracies especially in samples which may contain high dissolved solids and/or acid concentrations. The use of a peristaltic pump may lessen these interferences. If these types of interferences are operative, they must be reduced by dilution of the sample. Another problem which can occur from high dissolved solids is salt buildup at the tip of the nebulizer. This affects aerosol flow-rate causing instrumental drift. Wetting the argon prior to nebulization, the use of a tip washer, or sample dilution have been used to control this problem. This problem can also be alleviated by using a Bergener nebulizer instead of a Meinhardt nebulizer. Also, it has been reported that better control of the argon flow rate improves instrument performance. This is accomplished with the use of mass flow controllers.

4.1.3 Chemical Interferences - these interferences are characterized by molecular compound formation, ionization effects and solute vaporization effects. Normally these effects are not pronounced with the ICP technique, however, if observed they can be minimized by careful selection of operating conditions (that is, incident power, observation position, and so forth), buffering of the sample and matrix matching. These types of interferences can be highly dependent on matrix type and specific analyte element.

4.2 Generally, whenever a new or unusual sample matrix is encountered, a series of tests on the matrix-type are performed, e.g., background check of the sample, sample overlay with standards, etc., prior to analyzing samples associated with that matrix. If the problems associated with the new matrix cannot be overcome, the sample must either be diluted appropriately (and the Reporting Limit raised accordingly) or analyzed by an acceptable different method.

## 5. Safety

The toxicity and carcinogenicity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be minimized by good laboratory practices. Normally accepted laboratory safety practices should be followed during reagent preparation and instrument operation. Always wear safety glasses or full-face shield for eye protection when working with these reagents. Each laboratory is responsible for maintaining a current safety plan, a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this SOP.

## **6. Apparatus and Materials**

### **6.1. Inductively coupled argon plasma:**

- 6.1.1 Thermo Jarrell Ash (TJA) ICAP 61E Trace Purge Analyzer (with an axial torch) controlled by a computer.
- 6.1.2 TJA radio-frequency generator.
- 6.1.3 High purity (99.99%) liquid argon.
- 6.1.4 A variable speed peristaltic pump which is used to deliver both standards and samples to the nebulizer.
- 6.1.5 Computer controlled mass flow controllers which regulate the argon flow rates.

### **6.2. A balance which has the capability to measure 0.1mg.**

### **6.3. Labware (See Section 6.10 of EPA Method 200.7 Rev. 4.4).**

## **7. Reagents and Solutions**

### **7.1 Reagents - All reagents must be of high purity and suitable for trace metals analysis.**

- 7.1.1 Hydrochloric acid, concentrated - HCl (GFS HCl, 37% Reagent ACS or equivalent)
- 7.1.2 Nitric acid, concentrated - HNO<sub>3</sub> (GFS HNO<sub>3</sub>, Redistilled or equivalent)
- 7.1.3 Reagent grade water – ASTM Type I Water

### **7.2 Solutions - Refer to Table 1 for standard solutions preparation summary.**

#### **7.2.1 Calibration Stock Standard Solutions - Claritas Custom Standards manufactured by Spex CertiPrep under UL ISO 9001 Quality Assurance Program.**

- 7.2.1.1 Calibration Standard 1 - SPEX CertiPrep Custom Claritas Standard (250 ppm of Ag, As, B, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sb, Sn, Sr, Ti, Tl, V, and Zn) or equivalent.

- 7.2.1.2 Calibration Standard 2 - SPEX CertiPrep Custom Claritas Standard (250 ppm of Al, Ca, Fe, Mg, K, Na and Si) or equivalent.

#### **7.2.2 Working Calibration Solution – The Working Calibration Solution is prepared from the Stock Calibration Standard Solutions (7.2.1) to a final concentration of 1,000 ug/L for all elements except for Al, Ca, Fe, K, Mg, Na and Si which are 10,000 ug/L. The solution is in 2% HNO<sub>3</sub> and 5% HCl.**

- 7.2.3 Blanks – Four types of blanks are required for the analysis. The (1) calibration blank is used in establishing the analytical curve, the (2) initial calibration blank/continuing calibration blank (ICB/CCB) run after the calibration check standards to assess carryover, (3) a rinse blank is used to flush the instrument uptake system and nebulizer between standards, check solutions, and samples to reduce memory interferences and (4) a Laboratory Reagent Blank/Prep Blank (LRB/PB) is used to assess possible contamination from the sample preparation procedure and to assess spectral background.**
- 7.2.3.1 The calibration blank is prepared by adding HNO<sub>3</sub> and HCl to reagent grade water to the same concentrations used for the calibration standard solution.**
- 7.2.3.2 The rinse blank is prepared by acidifying reagent grade water to the same concentration of the acids as used in the calibration blank.**
- 7.2.3.3 The ICB and CCB are prepared by acidifying reagent grade water to the same concentration of acids as used in the calibration blank**
- 7.2.3.4 Laboratory reagent blank (LRB)/Prep blank (PB) - must contain all the reagents in the same volumes as used in digesting the samples. The LRB/PB must be carried through the same preparation scheme as the samples including digestion, if applicable.**
- 7.2.4 Initial Calibration Verification/Continuing Calibration Verification Solution (ICV/CCV) – These verification standard solutions are used to initially and periodically verify instrument performance during analysis. The ICV/CCV stocks must be obtained from a source different from the calibration stock standard solutions and prepared in the same acid mixture as the calibration standards. The concentration of the analytes in the ICV/CCV solution is 200 ug/L for all elements except Al, Ca, Fe, K, Mg, Na and Si which is 5,000 ug/L.**
- 7.2.4.1 Claritas Custom Standard - ICV1, 250ppm ( Ag, As, B, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sb, Sn, Sr, Ti, Tl, V, and Zn)**
- 7.2.4.2 Claritas Custom Standard - ICV2, 250ppm (Al, Ca, Fe, K, Mg, Na, Si)**
- 7.2.5 Low Level Check (ICV/50, ICV/20 and ICV/10) – The low level checks are used to initially and periodically verify instrument performance at lower concentration levels. The concentration of the analytes should be at or above the analyte reporting limit. Al, Ca, Fe, K, Mg, and Na are not evaluated in these low level check standards. The instrument performance low level checks are at 2%, 5% and 10% dilution of the ICV. The concentration of analytes of concern in ICV/50 are 4 ug/L for ICV1 elements and 100 ug/L for ICV2 elements; ICV/20 are 10 ug/L for the ICV1 elements and 250ug/L for ICV2 elements. The concentration**



of the analytes of concern in the ICV/10 are 20 ug/L for ICV1 and 500 ug/L for ICV2.

- 7.2.6 Internal Standard Solution (5ppm Y; Li 400ppm) – The normal calibration procedure for arc/spark involve the use of an internal standard. An element not found in the matrix being analyzed is added to each standard and each sample. Should the volume of aspirated sample change a corresponding intensity change will occur for all elements. Since the ratio remains constant, the possible error is eliminated.
- 7.2.7 Profiling Solution (5ppm As) – External problems like temperature and humidity changes can cause short and long term drift. This drift is due to the expansion or contraction of the focal curve with the result that the analytical line moves in relation to the measuring device. Periodic profiling corrects for this drift.
- 7.2.8 Inter-Element Correction (IEC) Solution (previously known as Interferents Only Solution IOS) - When inter-element corrections are applied, a spectral interference check solution is needed containing concentrations of the interfering elements at levels that will provide an adequate test of the correction factors.

## **8. Sample Collection, Preservation, Storage and Holding Time**

8.1 Sample Collection - Samples must be collected in plastic or glass containers.

### **8.2 Preservation and Storage**

- 8.2.1 Aqueous samples - the samples are preserved using concentrated  $\text{HNO}_3$ . The preservation is performed either a) in the field at the time of collection, or b) in the Laboratory upon receipt (within one business day). If the samples are preserved in the Laboratory, the samples must be held for sixteen hours after acidification and then verified to a  $\text{pH} < 2$  prior to sample processing. If the sample  $\text{pH}$  is verified to be  $\text{pH} > 2$  after the sixteen hours, additional  $\text{HNO}_3$  must be added and the sample held for an additional sixteen hours until verified to a  $\text{pH} < 2$ . The samples are stored at room temperature.
- 8.2.2 Soil/Sediment/Sludge samples - these samples are preserved in a refrigerator at  $\leq 4^\circ\text{C}$ . Alternatively, the samples may be stored at  $\leq -20^\circ\text{C}$  in a freezer.
- 8.2.3 Biological Tissue samples - The samples are stored at  $\leq -20^\circ\text{C}$  in a freezer.
- 8.2.4 Waste Oil/Organic Solvents - these samples do not require any preservation. The

samples are stored at room temperature.

8.2.5 Drum Samples - no temperature requirement for these samples.

### 8.3 Holding time

8.3.1 Aqueous samples must be prepared and analyzed within six months of collection.

8.3.2 Soil/Sediment/Sludge samples must be digested and analyzed within six months of collection.

Note: If soil/sediment samples are stored at  $\leq -20^{\circ}\text{C}$ , the holding time is extended. The samples must be prepared within 12 months of collection and analyzed within 6 months of digestion.

8.3.3 Biological Tissue samples must be digested within 12 months of collection and analyzed within 6 months of digestion.

8.3.4 Waste Oil/Solvent samples - a holding time is not established for the digestion or analysis of these samples.

8.3.5 Drum Samples do not require any holding time.

## 9. Sample Preparation

All Environmental samples, e.g., aqueous, soil/sediment, waste oil/organic solvent, and biological tissue, including NPDES wastewater compliance monitoring samples, are digested in a mixture of acids using the procedures described in SOP Number C-116 "Digestion of Metals Aqueous, TCLP Extracts, Soil/Sediment, Sludge, Waste Oil/Organic Solvents, TCLP Extracts and Biological Tissue Matrices by DigiBloc".

## 10. Instrument Operating Conditions

Before using this method, the following procedure is followed to optimize plasma conditions. The analyst should follow Thermo Electron's instructions unless other conditions provide better performance.

10.1 Before lighting the plasma, make sure the following settings are in place:

Auxiliary gas- low

Nebulizer flow rate ~ 0.60L/min

Pump Rate ~ 140 rpm.

**Internal standard solution with a buffer**

It is important to ensure that there is no pulsing in any of the lines.

- 10.2 After lighting the plasma, make sure the above settings have not changed and verify that the RF power setting is at 950 W.
- 10.3 Allow the plasma to become stable. At a minimum, wait 30 minutes before proceeding.
- 10.4 Optically profile the spectrometer by aspirating a 5ppm arsenic solution. The spectrum shifter must be between -0.05 and +0.05.

## **11. Sample Analysis**

- 11.1 Configure the instrument settings to those in Section 10.
- 11.2 Fill in the sample ID file.
- 11.3 After the plasma has become stable, standardize the instrument using the mixed calibration standard solution (Section 7.2.2) and the calibration blank (Section 7.2.3.1). The average of three readings is to be used. Flush the system with the rinse blank for a minimum of 60 seconds between each standard.
- 11.4 After the completion of the initial requirements, samples should be analyzed in the same operational manner used in the standardization routine with a rinse blank also being used between all sample solutions, LFBs/LCSs-Aqueous, LFM/MSs, and check solutions.
- 11.5 During the analysis of samples, the laboratory must comply with the required quality control in Sections 14. Only for the "direct analysis" of drinking water is the sample digestion step of the LRB/PB, LFB/LCS-Aqueous, and LFM/MS not required.
- 11.6 Sample analysis consists of the following:

Calibration Blank

Mixed Standard

IPC/ICV

IPB/ICB (Calibration Blank solution)

Low Check Sample/ICV/50, ICV/20 and ICV/10 (either solution at or below the analyte MCL excluding Al, Fe, Mg, and Na)

SIC/IOS

LRB/PB  
LFBs/LCSs  
Samples  
LFM/MS  
IPC/CCV -must be analyzed at a minimum of every 10 samples  
IPB/CCB  
ICV/50, ICV/20, ICV/10  
SIC/IOS

Note : The IPC/CCV and IPB/CCB must be analyzed at a minimum of every 10 analyses and at the end of each analysis run.

11.7 Determined sample analyte concentrations that are 90% or more of the upper limit of the analyte LDR must be diluted with reagent grade water that has been acidified in the same manner as the calibration blank and reanalyzed. See Section 11.4.7. of EPA Method 200.7, Rev. 4.4.

11.8 Report Data as directed in Section 12.

## **12. Data Analysis and Calculations**

12.1 Refer to Appendix A for detailed instructions for data workup and/or upload into LabWorks.

### **12.2 Aqueous Samples - Undigested**

All dilution factors required as a result of dilutions made during analysis are applied at the instrument. Therefore, all of the aqueous sample results generated from the analysis (in ug/L ) can be reported directly from the instrument. All results are reported to two significant figures and, in most cases, are reported using reporting limits listed in Table 2.

### **12.3 Aqueous Samples - Digested**

Dilution factors required as a result of dilutions made during analysis are also applied at the instrument. Therefore, all of the aqueous sample results, in ug/L, generated from the analysis can be reported directly from the instrument. All results are reported to two significant figures and, in most cases, are reported down to the standard reporting limit listed in Table 2.

#### 12.4 Non-Aqueous Samples

All dilution factors required as a result of dilutions made during analysis are applied at the instrument. Therefore, all of the results, in ug/L, generated from the analysis can be used directly from the instrument. These "ug/L" results must then be converted to "mg/Kg" results. The ug/L result is multiplied by the final digestate volume in Liters, usually 0.050 L, and divided by the sample mass in grams, usually 0.50 g (the specific sample volume and mass are recorded in the metals sample preparation log book). For dry weight calculation, the mg/Kg results must be divided by the decimal version of the percent solids, e.g., 90% is 0.90. Refer to to SOP G-23 for Percent Dry Solids.

All mg/Kg results are reported to two significant figures and, in most cases, are reported using the reporting limits listed in Table 2, adjusted for percent solids correction for dry weight basis.

### 13. Method Performance

An initial demonstration of capability (DOC) must be performed each time there is a significant change in the chemistry of the method, a major modification to an existing instrument, or a new instrument is installed. A DOC is performed by each analyst designated to analyze samples using this method. An annual check must subsequently be performed and documented for each analyst using this method.

#### 13.1 Accuracy and Precision

##### 13.1.1 Initial Demonstration of Capability

An initial demonstration of capability study must be conducted for this method for each analyst using this method. The study consisted of the analysis of four standards which are from a source independent of the standard curve. The results of the standards must be within the acceptance criteria supplied by the manufacturer or within 10% if none are specified. The % RSD should be within 20%. The results of the accuracy and precision study (true value, % recovery, standard deviation and % RSD) are maintained by the Quality Assurance Officer for each analyst and are located in the Central Branch File.

##### 13.1.2 Continuing Demonstration of Capability

An annual continuing demonstration of capability study must be performed and documented. It may consist of either successfully analyzing a PT sample or analyzing

2 sets of AQC standards to within control limits as stated in section 13.1.1. The results of the continuing accuracy and precision study (true value, % recovery, standard deviation and % RSD or final report from the PT provider) are maintained by the Quality Assurance Officer for each analyst and are located in the Central Branch File.

### **13.2 Method Detection Limit (MDL)**

An MDL Study must be conducted for this method. The study is based on the requirements listed in 40 CFR Part 136 Appendix B. Specific procedures for conducting an MDL study can be found in SOP # G-8. The MDL Study comprised the analysis of seven reagent grade water samples fortified at a level between 2-3x the detection limit. The results of the MDL determination (true value, average concentration, standard deviation and calculated MDL) are maintained by the Quality Assurance Officer for each method and are located in the Central Branch File.

### **13.3 Linear Dynamic Range (LDR)**

The LDR must be determined by generating a normal linear calibration curve followed by the analysis of successively higher standard solutions. The results of these standard solutions are used to calculate % recovery. This is conducted until the % recovery fell below 90%. The last standard that had a % recovery of at least 90% is identified as the LDR limit.

The results of the LDR Study are maintained in a file next to the instrument. The LDR results must be below or equal to that listed as the upper range in EPA Method 200.7.

## **14. Quality Control**

### **14.1 Calibration Curve**

**Acceptance Criteria** - A calibration blank and one mixed standard are used to standardize the instrument. After standardization, the ICV and ICB are used to determine acceptance.

**Corrective Action** - If the results of the ICV or ICB are unacceptable, analysis must be discontinued, the cause determined and/or in the case of drift the instrument re-calibrated.

### **14.2 Initial Calibration Verification (ICV).**

**Acceptance Criteria** - Analyze the ICV solution from a separate identifiable source (different lot number or vendor from that of calibration standards) immediately following

the calibration. The result of the ICV solution must be within  $\pm 5\%$  of the true value for NPDES compliance monitoring samples and  $\pm 10\%$  for all other samples.

**Corrective Action** - If the calibration cannot be verified within the specified limits, re-analyze the ICV solution. If the results of the second analysis of the IPC/ICV solution is not within the acceptance limits for both types of samples (NPDES compliance monitoring samples and other samples), the analysis must be evaluated and the cause determined and the instrument re-calibrated. If the results of the second analysis of the IPC/ICV solution is not within the acceptance limits of NPDES requirements but within the acceptance limits for other program samples, a case narrative must be issued for samples that are non-compliant.

#### 14.3 Continuing Calibration Verification (CCV)

**Acceptance Criteria** - Analyze the CCV solution, from the same source as that used for the ICV, after a maximum of ten samples and at the end of the sample run. The results of each CCV solution must be within  $\pm 10\%$  of the true value for NPDES compliance monitoring samples ( $\pm 20\%$  for all other samples).

**Corrective Action** - If the calibration cannot be verified within the specified limits, re-analyze the CCV solution. If the results of the second analysis of the CCV solution is not within the acceptance limits, the analysis must be discontinued, the cause determined and the instrument re-calibrated. All samples following the last acceptable CCV solution must be reanalyzed.

#### 14.4 Initial Calibration Blank/Continuing Calibration Blank (ICB/CCB)

**Acceptance Criteria** - Analyze the calibration blank immediately following each calibration and after every CCV. All ICB/CCBs results must be  $< \text{the } |\text{Reporting Limit}|$ .

**Corrective Action** - If the result of the ICB/CCB is  $> |\text{Reporting Limit}|$ , the analysis should be stopped the problem identified, and the ICB/CCB reanalyzed. If the ICB/CCB results remain  $> |\text{Reporting Limit}|$ , the instrument must be recalibrated.

#### 14.5 Preparatory Blank (PB)/Laboratory Reagent Blank(LRB)

**Acceptance Criteria** - Analyze an LRB/PB per 20 samples or less per matrix. The PB/LRB results must be  $< \text{the } |\text{Reporting Limit}|$ .

**Corrective Action** - If the result of the PB/LRB is  $> |\text{Reporting Limit}|$ , then all associated samples with a concentration of  $\leq 10\times$  the amount found in the PB/LRB should be



reprepared and reanalyzed. If the samples cannot be reprepared, then all affected sample results must be either: qualified accordingly, or the Reporting Limit is raised to the amount found in the sample. Check with the team leader/section chief to determine which option should be used.

Sample results  $\geq 10\times$  the amount found in the PB/LRB are not considered to be affected by the blank contamination or drift, so no corrective action is needed.

#### 14.6 Laboratory Fortified Blank (LFB)/Laboratory Control Samples (LCS)

##### 14.6.1 Aqueous LCS

Acceptance Criteria - Analyze two aqueous LFB/LCS samples with each batch of aqueous samples of 20 or less. Calculate accuracy as percent recovery using the following equation:

$$\% \text{ Recovery} = \frac{\text{Average of 2 LFB/LCS 's}}{s} \times 100$$

where: LFB/LCS = laboratory fortified blank/laboratory control sample  
s = concentration of analytes added to fortify the LFB/LCS solution

The % recovery of the aqueous LFB/LCS must be within  $\pm 15\%$  of the true value for NPDES wastewater compliance monitoring samples and within  $\pm 20\%$  of the true value for all other environmental samples. The RPD of two LCSs should be  $< 20\%$ .

##### 14.6.2 Solid LCS

Acceptance Criteria - Analyze two solid LCS samples with each batch of solid samples of 20 or less. Calculate accuracy as percent recovery using the following equation:

$$\% \text{ Recovery} = \frac{\text{Average of 2 LCS 's, ng/Kg}}{\text{True Value, ng/Kg}} \times 100$$

The % recovery of the solid LCS must be within  $\pm 25\%$  of the true value or within the limits established by the vendor. The relative percent difference (RPD) of the duplicates should not exceed 25% for solid samples.

**Corrective Action for 14.6.1 and 14.6.2** - If the % recovery or %RPD results are outside the required control limits, the affected samples should be reprepared and reanalyzed. If the samples cannot be reprepared, then all affected sample results must be qualified accordingly.

#### **14.7 Laboratory Fortified Matrix (LFM)/Matrix Spike(MS) Recovery**

**Acceptance Criteria** - Fortify a known amount of analytes to one sample per matrix per project per batch of 20. The LFM/MS aliquot must be a duplicate of the aliquot used for sample analysis. When possible, the concentration should be the same as that added to the aqueous LFB/LCS, but should not exceed the midpoint concentration of the calibration curve. Calculate the percent recovery, corrected for background concentration measured in the unfortified sample aliquot, and compare these values to the control limits to the designated matrices recovery ranges :  $\pm 20\%$  for aqueous samples;  $\pm 25\%$  for solid samples (soils, sediment, and NAPL); and  $\pm 50\%$  for sludge and biological tissue samples. Percent recovery is calculated using the following equation:

$$R = \frac{C_s - C}{s} \times 100$$

where:

R = percent recovery,

C<sub>s</sub> = fortified sample concentration,

C = sample background concentration, and

s = conc. equivalent of metal added to sample.

**Corrective Action** - If % recovery of the MS is outside the required control limits, and the laboratory performance is shown to be in control, the recovery problem encountered is judged to be matrix related, not system related. The native sample result of the sample used to produce the MS must be qualified accordingly.

**Note:** The % recovery of the MS is not evaluated if the result of the unfortified sample concentration is  $\geq 1.0 \times$  the level used to fortify the sample.

#### **14.8 Serial Dilution Test**

**Acceptance Criteria** - Analyze a 20% dilution of the MS sample(s). The serial diluted sample result(s), adjusted for the dilution, should agree with the MS result(s) to within 20% RPD.

**Corrective Action** - If the % RPD is outside the required control limits, and the

laboratory performance is shown to be in control, the precision problem encountered is judged to be matrix related, not system related, and the sample should be qualified accordingly.

#### 14.9 Low-Level Checks - (ICV/50, ICV/20 and ICV/10)

**Acceptance Criteria** - Analyze the ICV/50, ICV/20 and ICV/10 standards, from a separate identifiable source other than the calibration standards, immediately following the ICV and ICB. The ICV/50, ICV/20 and ICV/10 should also be analyzed after every CCV. The % recovery of the ICV/50, ICV/20 and ICV/10 must be within  $\pm 30\%$  of the true value for all analytes of interest.

**Corrective Action** - If the ICV/50, ICV/20 and ICV/10 cannot be verified within the specified limits, analysis must be evaluated, the cause determined and/or in the case of drift the instrument re-calibrated. If the ICV/50 and ICV/20 are not within the specified limits for the elements of interest but the ICV/10 is within the required limits, then the Reporting Limit is raised up to the ICV/10 level as long as the sample project requirement allows.

#### 14.10 Spectral Interference Check (SIC)/Inter-Element Correction (IEC) Solution (formerly known as Interferents Only Solution - IOS)

**Acceptance Criteria** - All metal results (required by the project(s), except for Al, Fe, Ca, K, Mg, and Na, should be below the established Reporting Limits listed in Table 2

**Corrective Action** - If a required metal result is  $>$  the |Reporting Limit|, the individual interferent metals must be analyzed independently to assess which metal is causing the interference. Once identified, the appropriate inter-element correction factor(s) and background correction point(s) must be reviewed, and where appropriate, adjusted. After the adjustment is completed, the IEC standard must be re-analyzed. Once a successful IEC is analyzed, the analysis can commence.

A corrective action is not required if one of the following conditions are met:

1. If the metal that is "affected" by the interferent is not required for the project(s) in question;
2. If the concentration of the metal that is "affected" by the interferent is  $<$  the |Reporting Limit|;
3. If the concentration of the metal causing the interference in the "affected" environmental sample(s) is at a trace level, i.e.,  $< 10000$  ug/L (the level used in our mixed calibration standard; section 7.2.1).

#### 14.11 Triplicate Integrations

**Acceptance Criteria** - Each analysis consists of three separate integrations or readings. This includes the calibration standards, quality control samples and all associated environmental samples. The average of the three measurements is used for reporting results. The RSD must be  $\leq 20\%$  for all results that are  $\geq$  the reporting limit.

**Corrective Action** - If the RSD for a calibration standard, quality control sample and environmental sample is outside the control limits, the analysis must be repeated. If the RSD is still outside the control limits, the analysis must be terminated, and repeated after correcting the problem. If the RSD is still outside the control limits, and the laboratory performance, i. e. CCV, is shown to be in control, the RSD problem encountered is judged to be matrix related, not system related, and the sample should be qualified accordingly.

## **15. Reporting and Validation**

**15.1 Reporting Limits** - The reporting limits are calculated based on the concentration of the lowest calibration standard analyzed. The reporting limits are matrix and dilution dependent. All results are reported to 2 significant figures.

### **15.2 Sample Data Package**

The sample data package should include but not be limited to the following:

- ICAP-AES QA/QC Checklist with all relevant information entered;
- Copies of Log Book entries of Analysis Run Log; Sample Digestion Log, and if required, Sample Percent Solids Log and/or pH Log;
- Calibration Report;
- Summary Analysis Form;
- QC Summary Forms; and
- Instrument generated Sample Data

**15.3 Laboratory Information Management System (LIMS)** - The analyst enters the data on the LIMS under the appropriate analytical codes.

**15.4 Data Validation** - The data package is given to the reviewer. The review is done by a peer who was not involved in the analysis. Upon completion of the review, including validation of all the appropriate codes in the LIMS for the particular project(s), the data reviewer will sign and date the QA/QC Checklist.

**15.5 Data Records** - All project records associated with the data package are filed under one designated project file. All other projects associated with the data package are

referenced to this designated project file via a "cross reference form". The "cross reference form" is placed in each of the project files that were associated with the data package.

The data package is placed in the bin identified for the designated project file. The records for this designated project file are filed in our locked record cabinets once all data from the project, e.g., non-metal inorganic data, organic data, microbiology data, etc. has been reviewed by the appropriate staff.

## **16. Pollution Prevention**

- 16.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.
- 16.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.
- 16.3 For information about pollution prevention that may be applicable to laboratories and research institutions, consult *Less is Better: Laboratory Chemical and Management for Waste Reduction*, available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington D.C. 20036, (202)872-4477.

## **17. Waste Management**

The USEPA requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process waste should be characterized and disposed of in an acceptable manner. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For

further information on waste management consult the Region 2 SOP G-6, "*Disposal of Samples and Hazardous Wastes*".

## 18. REFERENCES

- U. S. Environmental Protection Agency. "*Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry*," Method 200.7, Revision 4.4, May 1994.
- U. S. Environmental Protection Agency, Region 2, SOP G-6 "*Disposal of Samples and Hazardous Wastes*."
- U. S. Environmental Protection Agency, Region 2, SOP G-8 "*Laboratory Policy for the Determination of Method Detection Limits (MDLs)*."
- U. S. Environmental Protection Agency, Region 2, SOP G-15 "*Laboratory Definitions and Data Qualifiers*."
- U. S. Environmental Protection Agency, Region 2, SOP G-23 "*Percent Dry Solids*."
- U. S. Environmental Protection Agency, Region 2, SOP C-116 "*Preparation of Aqueous, TCLP Extracts, Soil/Sediment/Sludge, Waste Oil/Organic Solvents, and Biological Tissue Matrices by Block Digestion*."
- Method 2340 B "*Hardness by Calculation*"\_Standard Methods for the Examination of Water and Wastewater, 20<sup>th</sup> Edition-1998.
- U. S. Environmental Protection Agency, Solid Waste 846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 6010C "*Inductively Coupled Plasma - Atomic Emission Spectrometry*" Laboratory Manual, Revision 3, November 2000.

## **APPENDIX A**

### **DATA WORKUP**

- Copy data database (e.g., 121604.dbf) and the sample data file (samples.dbf) to a rewritable CD. The file nomenclature is based on the date of analysis, e.g., 121604.dbf - 12 is month of December, 16 is the date and 04 is the year 2004.
- Login to LABWORKS
- Select Results from the main menu
- Select Instrument Conversion
- Select file name by recalling the data file, e.g., 121604.dbf
- Click OK. After OK is clicked a file is created converting the samples to .grf files
- Upload the correct .grf file into each individual sample by selecting the sample number with the corresponding test codes in the project.
- Right click on the results cell
- Select Modify Results
- Select Load Results
- Select the correct file from L:\Labwork\_ES\LWDATA5\INTERFACE\TJA\_DBF drive
- Click OK
- Check results to ensure that they are correct
- Delete any test codes in the project LIMS codes that are not required
- Make sure the reporting limits reflect analytical and prep dilutions, if any.



**Table 1. Standard Solutions Preparation:**

Standard/Solution Name	Concentration Required
Std 1 - Calibration Blank/ ICB/Rinse Blank/CCB	Reagent grade water
Std 2	1000 ppb all elements except 10,000 ppb for Al, Ca, Fe, Mg, K, Na and Si
ICV/CCV	200 ppb for all elements except 5000 ppb Al, Ca, Fe, Mg, K, Na and Si
ICV/50	4 ppb all elements except 100 ppb for Al, Ca, Fe, Mg, K, Na and Si
ICV/20	10 ppb all elements except 250 ppb for Al, Ca, Fe, Mg, K, Na and Si
ICV/10	20 ppb all elements except 500 ppb for Al, Ca, Fe, Mg, K, Na and Si
IEC Solution (previously known as IOS)	300,000 ppb Al, Ca, Fe, Mg and 60,000 ppb Na
Profile Solution	5,000 ppb As
Internal Standard	2,000,000 ppb Li 10,000 ppb Y

Note : The diluent used in preparing all the above standard solutions must be reagent grade water with 2% HNO<sub>3</sub> and 5% HCl.

**Table 2. Reporting Limits - Aqueous and Soil/Sediment**

Element	MDL, ug/L	Reporting Limit, ug/L	Reporting Limit, mg/Kg
Ag	1.6	6	0.6
Al	48.5	200	200
As	2.3	8	0.8
B	2.3	8	0.8
Ba	1.6	6	0.6
Be	1.5	5	0.5
Ca 396.8	51.1	1000	100
Ca 317.9	51.4	1000	100
Cd	1.3	4	0.4
Co	2.3	8	0.8
Cr	1.8	6	0.6
Cu	2.7	10	1
Fe 259.9	42.5	200	20
Fe 271.4	55	200	20
K	126.0	1000	100
Mg 285.2	47.0	1000	100
Mg 279.0	54.8	1000	100
Mn	1.4	5	0.5
Mo	2.1	8	0.8
Na	589.0	1000	100
Ni	1.4	5	0.5
Pb	2.1	7	0.7
Se	1.9	7	0.7
Sb	3.7	14	1.4
Si	81.4	300	30
Sn	2.5	9	0.9
Sr	1.7	6.0	0.6
Tl	2.2	8	0.8
Tl	5.5	20	2
V	2.7	10	1
Zn	2.2	8	0.8

- Notes:
- 1) The IDL results were obtained using the analysis of seven ICV/40 standards analyzed on separate days
  - 2) The IDLs for all elements, except K and Si, were obtained by multiplying the standard deviation of the seven analysis by 3.14
  - 3) The Reporting Limits were obtained by multiplying the IDLs by 3.6 (1.2x3) and rounding to 2 significant figures

## **APPENDIX D**

### **HISTORICAL ARSENIC DATA RESULTS (YEAR 1992 AND YEARS 1994 THROUGH 1999)**

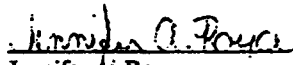
(USEPA/ERTC 1999)

**FINAL REPORT**  
**Vineland Chemical Site**  
**Field Investigation**  
**Vineland, Cumberland County, NJ**  
**May 1999**

U.S. EPA Work Assignment No.: 3-195  
WESTON Work Order No.: 03347-143-001-3195-01  
U.S. EPA Contract No.: 68-C4-0022

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## 1.0 INTRODUCTION

### 1.1 Objective

The objective of this study was to collect sediment, soil and water data to assess the public health hazard for arsenic contamination at three beaches along the Maurice River, two beaches along Union Lake, a potable water well at the Union Lake Sailing and Tennis Club, and potable water wells at two houses adjacent to the Vineland Chemical site. The data was evaluated against human health risk based action levels. This study was part of an annual monitoring program performed at beaches along the Maurice River and Union Lake.

### 1.2 Site Background

The Vineland Chemical site is a 54-acre manufacturing facility located in Vineland, Cumberland County, NJ. The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles, a practice that has since been discontinued. This resulted in soil and groundwater contamination in the vicinity of the site. In addition, runoff during storm events and recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including the Blackwater Branch, Maurice River, and Union Lake. Arsenic-contaminated groundwater, process water, non-contact cooling water, and storm water runoff are currently treated on site. Effluent containing approximately 0.7 milligrams per liter (mg/L) arsenic is discharged from the wastewater treatment facility to an unlined lagoon where it percolates into the ground.

Previous studies have investigated the extent and magnitude of arsenic contamination in the Maurice River watershed (Faust et al. 1983, Weston 1988). Data available concerning arsenic contamination indicates that both the water and sediment are contaminated downstream of the site. The maximum arsenic concentrations detected in surface water, sediment and interstitial water were 2,780 micrograms per Liter ( $\mu\text{g/L}$ ), 14,000 milligrams per kilogram (mg/kg) and 12.5 mg/L, respectively. The New Jersey Department of Environmental Protection (NJ DEP) and the United States Environmental Protection Agency (U.S. EPA) standards for arsenic in drinking water are 0.05 mg arsenic/L (U.S. EPA 1993). The extent of arsenic contamination ranges from the Blackwater Branch in the vicinity of the Vineland Chemical facility to a point approximately 26.5 miles downstream from the site.

Sediment, soil and surface water samples were collected at four beaches downstream of the site as part of an annual monitoring program (Weston 1992, 1995a, 1995b, 1996, 1997, 1998). In addition, potable water samples were collected from a well downstream of the site in 1996 and 1997. In 1998, additional potable water samples were collected at two houses adjacent to the Vineland Chemical property. Arsenic was not detected in any of the well samples.

In May 1999, the U.S. EPA Region II requested that the U.S. EPA/Environmental Response Team Center (ERTC) collect sediment, soil and water samples from three beaches along the Maurice River, two beaches at Union Lake, and potable water samples from the Union Lake Sailing and Tennis Club and from two houses adjacent to the site.

## 2.0 METHODOLOGY

### 2.1 Field Sampling Design

The sampling was conducted to assess the potential human exposure to arsenic and should not be interpreted as a comprehensive extent of contamination. The specific sampling locations were

determined by the U.S. EPA Region II Remedial Project Manager (RPM), Matthew Westgate (Figure 1). On 29 April 1999, two sediment, one soil and one disturbed water sample were collected at each of the five previously sampled beaches. The disturbed water sample was used to simulate potential human exposure to arsenic contaminated surface water and sediment during beach use. Potable water samples were collected from Union Lake Sailing and Tennis Club and from two houses adjacent to the site. The eight locations sampled were as follows:

Sampling Location	Description of Sampling Location
Alliance Beach	Upstream of Almond Beach, unmaintained public day-use area.
Almond Beach	Publicly maintained beach area approximately 100-150 feet long.
BA Beach	Downstream of Almond Beach, consisting of an unmaintained public day-use area.
Union Lake Beach	Privately maintained beach, downstream of the site.
Union Lakes Sailing and Tennis Club	Privately maintained club, downstream of the site, potable water well.
South End of Union Lake Beach	Publicly maintained beach at the southern end of Union Lake.
House #1	1618 Wheat Rd., across from the site.
House #2	1509 Wheat Rd., adjacent to the site.

→ All beach sampling areas were characterized by shallow depth (less than three feet), gradual slope and sluggish flow. The sediment was sandy near the shore with coarser sand and small to medium gravel in deeper areas. Thin deposits of black silt were evident at depositional areas along the bottom.

A Horiba U-10@ Water Quality Monitoring Instrument was used at each sample location to measure temperature, pH, dissolved oxygen, conductivity, and salinity. The Horiba U-10@ was operated according to the manufacturer's operating manual.

## 2.2 Sediment, Soil and Water Sampling

Two sediment samples were collected from each of the five beaches sampled using a decontaminated Ponar dredge according to ERTC/REAC SOP #2016, *Sediment Sampling*. One sediment sample was collected upstream of the beach and one downstream of the beach. Sediment was collected from depositional areas where there was evidence of black silt. The dredge contents were composited into an aluminum tray, homogenized and transferred to a labeled 8-ounce glass jar.

Surface soil samples (0-4 inches below ground surface) were collected from each beach area using plastic trowels according to ERTC/REAC SOP #2012, *Soil Sampling*. The soil sample was composited into an aluminum tray, homogenized and transferred to a labeled 8-ounce glass jar.

Surface water samples were collected as per modification of ERTC/REAC SOP #2013, *Water Sampling*. The modification included collecting samples directly into a 1-L polyethylene bottle while

Submerged  
bottle

disturbing the adjacent sediments. The samples were collected at a depth of 6 to 12 inches below the surface and approximately 6 inches above the bottom. The disturbed water sample was used to simulate potential human exposure to arsenic contaminated surface water and sediment during beach use.

The potable water samples were collected according to ERTC/REAC SOP #2051, *Potable Water Sampling*. All water samples were preserved after collection using 40 percent nitric acid to a pH of less than 2.

After each sample was collected, the labeled sample jars were placed in a resealable plastic bag and stored in a sample cooler on wet ice [4 degrees Celsius ( $^{\circ}\text{C}$ )]. Field documentation (field logbook notes, and chain of custody forms) are located in Appendix A. The samples were delivered to the REAC Inorganic Laboratory in Edison, New Jersey, on 29 April 1999. The final analytical results are located in Appendix B.

### 3.0 RESULTS

#### 3.1 Sediment Samples

Arsenic was detected in all sediment samples at concentrations ranging from 1.7 to 11 mg/kg (Table 1). The maximum concentration of arsenic (11 mg/kg) was detected in the upstream sample from the South end of Union Lake and the minimum concentration of arsenic (1.7 mg/kg) was detected in the downstream sample from BA Beach. Sediment grain size was qualitatively characterized as containing predominantly large grain sizes such as sand and small to medium gravel. Sediment collected from all five beaches contained a fine layer of highly suspendible silt.

#### 3.2 Soil Samples

Arsenic was detected in three of the five beach soil samples at concentrations ranging from 0.43 to 2.6 mg/kg (Table 1). The maximum concentration of arsenic (2.6 mg/kg) was detected at Union Lake and the minimum concentration of arsenic (0.43 mg/kg) was detected at Almond Beach. Arsenic was not detected at BA Beach and at South End of Union Lake Beach above the method detection limit (MDL) of 0.41 mg/kg. The soil at all five locations consisted primarily of sand and some small gravel.

#### 3.3 Water Samples

Arsenic was detected in all five surface water samples at concentrations ranging from 0.006 to 0.24 mg/L (Table 2). The maximum concentration of arsenic (0.24 mg/L) was detected at Alliance Beach and the minimum concentration of arsenic (0.006 mg/L) was detected at Union Lake. Arsenic was not detected (MDL = 0.002 mg/L) in Union Lake Sailing and Tennis Club, House #1 and House #2 potable water samples.

#### 3.4 In-Situ Water Quality

In-situ water quality parameters were consistent at all locations (Table 3). Temperature ranged from 13.2 to 16.9  $^{\circ}\text{C}$  and dissolved oxygen ranged from 8.66 to 11.5 mg/L. The pH ranged from 5.7 to 8.69 standard units. Conductivity ranged from 0.061 to 0.095 millimhos per centimeter (mmhos/cm). Salinity was measured at zero parts per thousand (ppt) at all locations.

### 3.5 Field Blanks

Arsenic was not detected at concentrations above the MDL (0.002 mg/L for water and 0.48 mg/kg for soil and sediment) in any field blanks. As such, it is unlikely that any contamination can be attributed to improper sample collection and handling.

## 4.0 DISCUSSION AND SUMMARY

Arsenic was detected in sediment samples collected at all locations at concentrations ranging from 1.7 to 11 mg/kg. The sediment in the Maurice River and Union Lake contains a high content of organic matter. Arsenic is typically adsorbed to the organic portion of sediment (Eisler 1988). Therefore, the arsenic may have been bound to the fine organic matter that was observed in the sediment.

Arsenic was detected in three of the five soil samples collected at concentrations ranging from 0.43 to 2.6 mg/kg. The soil samples were composed of coarse sand and some small gravel with very little organic matter. Arsenic typically binds to the organic matter in soil (Eisler 1988). The lack of organic matter in these samples implies a lack of adequate binding sites for arsenic. Therefore, rain or other inputs may cause the leaching of arsenic out of the soil and may account for the low concentrations of arsenic in these soil samples.

Arsenic was detected in all five surface water samples at concentrations ranging from 0.006 mg/L to 0.24 mg/L. Arsenic concentrations were above the U.S. EPA drinking water standard of 0.05 mg/L (U.S. EPA 1993) at two of the five beaches sampled (Alliance Beach and Almond Beach). Water samples were collected while disturbing the sediments so that particles of the highly suspendible fine silt layer were incorporated in the sample. Arsenic detection may be attributed to the organic fraction of the disturbed sediments present in the water samples. Riedel *et al.* (1988) found that the predominate component of detectable arsenic in water is associated with the sediment solids. Arsenic was not detected (MDL = 0.002 mg/L) in the potable well water samples taken at the Union Lake Sailing and Tennis Club, House #1 or House #2.

Concentrations of arsenic in the surface water collected from the Maurice River tended to be higher than the concentrations in surface water collected from Union Lake, with the exception of the BA Beach sample. Several reasons for this appear to exist. First, the Maurice River is directly downstream of the point-source of contamination and flows into Union Lake. Second, other tributaries flowing into Union Lake may cause the dilution of arsenic concentrations detected at these locations.

There are a number of factors that affect arsenic concentrations, including storm events, groundwater flow, flooding, grain size and sampling technique. Historic data for sediment, soil and water were compiled in Table 4 and Figures 2-4. No trends are discernable in the data as the concentration of arsenic in all matrices have remained relatively constant over time.

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Table 1. Results of the Arsenic Analysis in Soil/Sediment  
 Vineland Chemical Site  
 Vineland, Cumberland County, New Jersey  
 May 1999

(Results reported in mg/kg)

Sample ID	Matrix	Location	Conc	MDL
A19255	Soil	Alliance Beach	0.59	0.41
A19256	Sediment upstream	Alliance-U	10	0.42
A19257	Sediment downstream	Alliance-D	3.4	0.41
A19251	Soil	Almond Beach	0.43	0.39
A19252	Sediment upstream	Almond-U	3.4	0.44
A19253	Sediment downstream	Almond-D	1.9	0.41
A19259	Soil	BA Beach	U	0.47
A19260	Sediment upstream	BA-U	6.6	0.41
A19261	Sediment downstream	BA-D	1.7	0.44
A19267	Soil	Union Lake	2.6	0.41
A19268	Sediment upstream	Union Lake-U	6.0	0.47
A19269	Sediment downstream	Union Lake-D	2.8	0.42
A19263	Soil	So. End Union Lake	U	0.48
A19264	Sediment upstream	So. End Union Lake-U	11	0.38
A19265	Sediment downstream	So. End Union Lake-D	5.1	0.42

MDL - method detection limit

U - not detected

mg/kg - milligram per kilogram

Table 2. Results of the Arsenic Analysis in Water  
 Vineland Chemical Site  
 Vineland, Cumberland County, New Jersey  
 May 1999

(Results reported in mg/L)

Sample ID	Location	Conc.	MDL
A19258	Alliance Beach	0.24	0.002
A19254	Almond Beach	0.11	0.002
A19262	BA Beach	0.01	0.002
A19270	Union Lake	0.006	0.002
A19271	Union Lake Yacht Club House	U	0.002
A19266	South End Beach, Union Lake	0.02	0.002
A19272	House #1	U	0.002
A19273	House #2	U	0.002

MDL - method detection limit

U - not detected

mg/L - milligrams per Liter



**Table 3. In-Situ Water Quality Parameters**  
**Vineland Chemical Site**  
**Vineland, New Jersey**  
**May 1999**

Location	Temperature ( C )	Dissolved Oxygen (mg/L)	pH	Conductivity (mmhos/cm)	Salinity (ppt)
Alliance Beach	15.1	8.91	6.30	0.079	0.00
Almond Beach	13.5	8.66	6.40	0.077	0.00
B-A Beach	14.6	9.65	5.83	0.079	0.00
Union Lake	16.9	9.65	5.70	0.091	0.00
Union Lake Yacht Club	14.8	11.50	7.00	0.061	0.00
So. End Union Lake	15.3	9.40	5.90	0.093	0.00
House #1	14.0	11.30	6.10	0.095	0.00
House #2	13.2	11.24	8.69	0.085	0.00

C - degrees Celsius

mg/L - milligrams of dissolved oxygen per liter of water

mmhos/cm - micromhos per centimeter

NTU - nephelometric turbidity units

ppt - parts per thousand

Table 4. Concentrations of Arsenic in Sediment, Soil and Water from 1992-1999  
Vineland Chemical Site  
Vineland, New Jersey  
May 1999

Year Sampled	Matrix	Units	Alliance Beach	Almond Beach	BA Beach	Union Lake Beach	South End Union Lake Beach
1992	Water	(mg/L)	0.52	0.15	0.036	NS	NS
	Soil	(mg/kg)	NS	NS	NS	NS	NS
	Sediment	(mg/kg)	11.1	7.9	11.8	NS	NS
1994	Water	(mg/L)	0.023	0.023	0.039	NS	NS
	Soil	(mg/kg)	U (0.45)	0.92	U (0.44)	NS	NS
	Sediment	(mg/kg)	9.65	2	19.3	NS	NS
1995	Water	(mg/L)	0.1	0.2	0.077	NS	NS
	Soil	(mg/kg)	2.2	0.86	4	NS	NS
	Sediment	(mg/kg)	7.75	3.85	5.95	NS	NS
1996	Water	(mg/L)	0.04	0.11	0.085	0.016	NS
	Soil	(mg/kg)	0.89	0.76	0.67	1.3	NS
	Sediment	(mg/kg)	1.6	5.3	10.5	5	NS
1997	Water	(mg/L)	0.11	0.02	0.021	0.0066	NS
	Soil	(mg/kg)	0.49	0.46	8.1	3.1	NS
	Sediment	(mg/kg)	2.2	4.35	3.25	2.65	NS
1998	Water	(mg/L)	0.12	0.054	0.099	0.0088	0.026
	Soil	(mg/kg)	1.1	1	U (0.41)	1.2	2.3
	Sediment	(mg/kg)	4.2	17	38	2.5	17.5
1999	Water	(mg/L)	0.24	0.11	0.01	0.006	0.02
	Soil	(mg/kg)	0.59	0.43	U (0.47)	2.6	U (0.48)
	Sediment	(mg/kg)	6.7	2.7	4.2	4.4	8.1

Note: Sediment concentrations reflect a mean of the upstream sample and the downstream sample

NS - Not Sampled

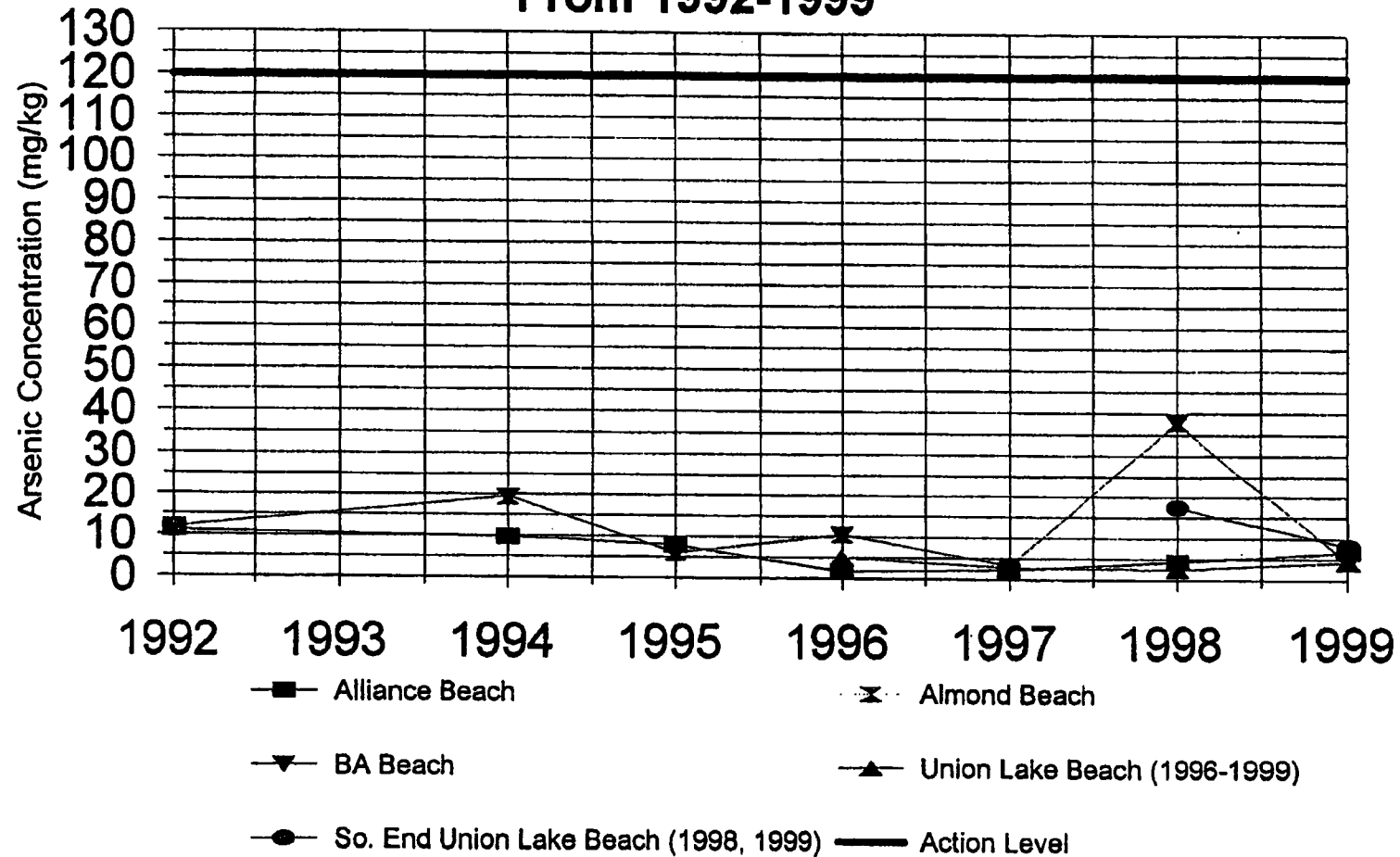
U - not detected at indicated concentration

Action Limit: Soil/Sediment - 120 mg/kg, Water - .05 mg/L

mg/L - milligrams per Liter

mg/kg - milligram per kilogram

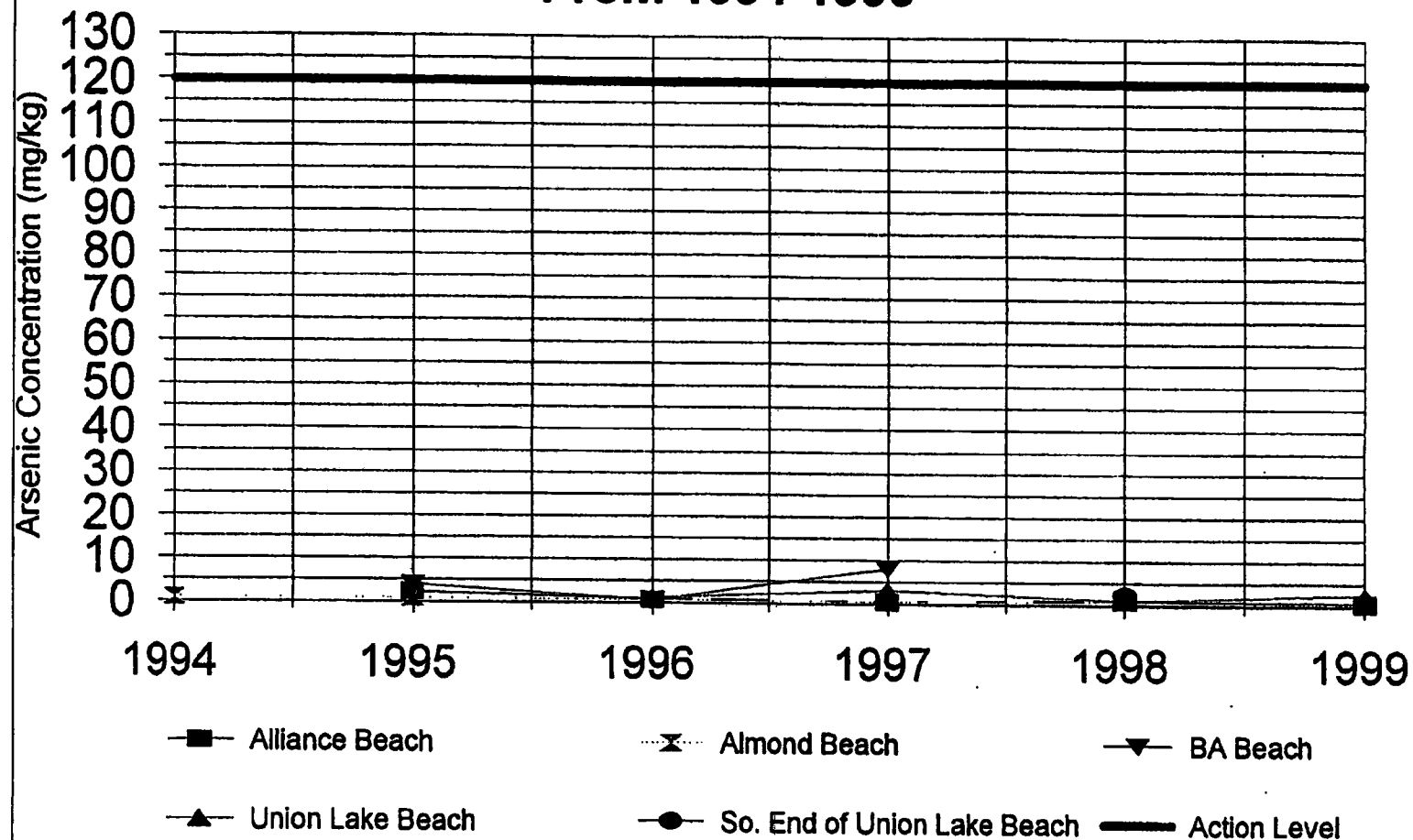
## Arsenic Concentrations In Sediment From 1992-1999



U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER  
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT  
98-C4-0022  
W.O. # 03347-143-001-3196-01

FIGURE 2  
ARSENIC CONCENTRATIONS IN SEDIMENT FROM 1992 - 1999  
VINELAND CHEMICAL SITE  
VINELAND, NEW JERSEY  
MAY 1999

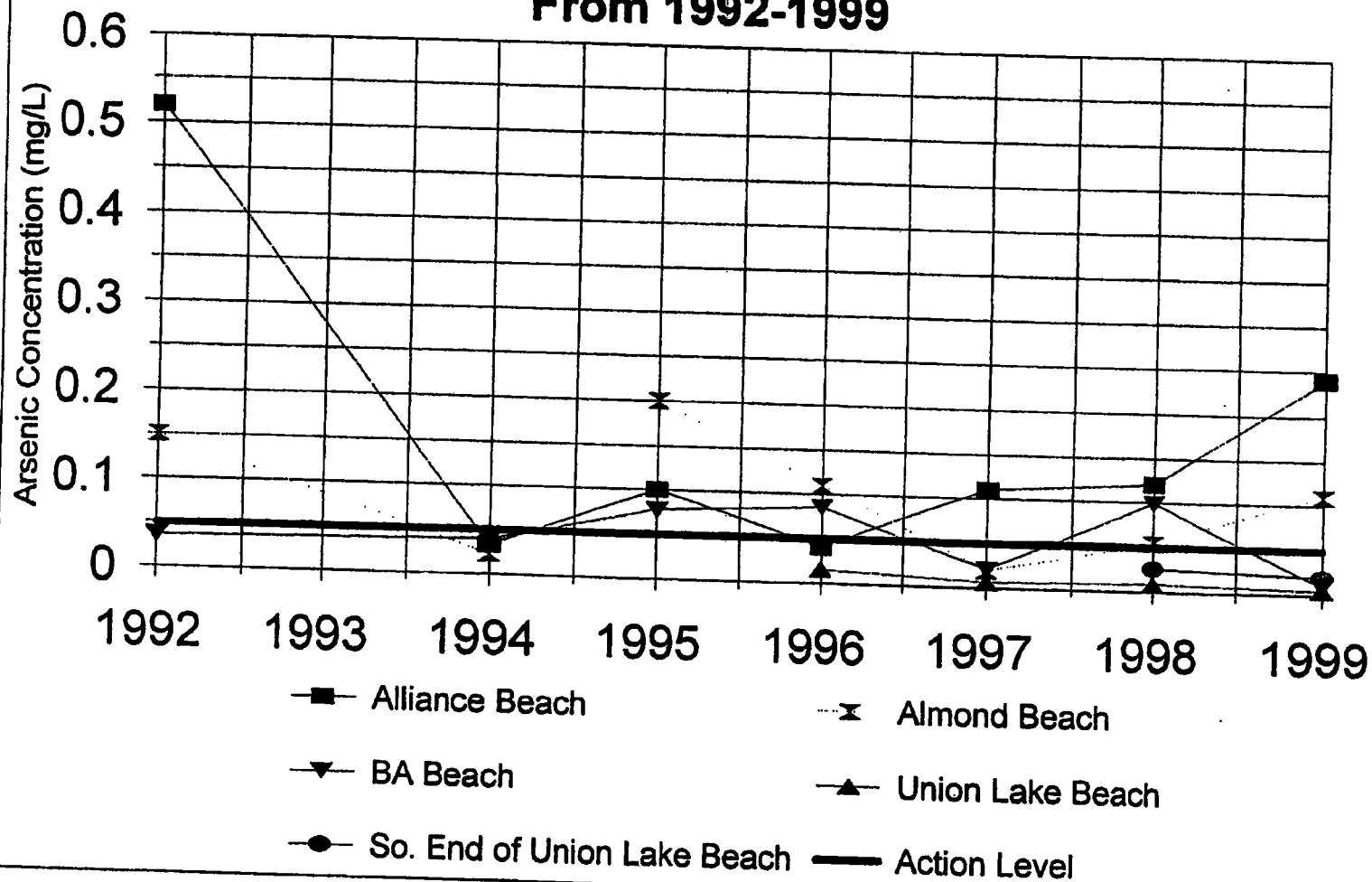
## Arsenic Concentrations in Soil From 1994-1999



U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER  
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT  
00-C4-0022  
W.O. # 03347-143-001-3195-01

FIGURE 3  
ARSENIC CONCENTRATIONS IN SOIL FROM 1994 - 1999  
VINELAND CHEMICAL SITE  
VINELAND, NEW JERSEY  
MAY 1999

## Arsenic Concentrations in Water From 1992-1999



U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER  
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT  
08-C4-0022  
W.D. # 03347-143-001-3105-01

FIGURE 4  
ARSENIC CONCENTRATIONS IN WATER FROM 1992 - 1999  
VINELAND CHEMICAL SITE  
VINELAND, NEW JERSEY  
MAY 1999

**APPENDIX A**  
**Field Documentation**  
**Vineland Chemical Site**  
**Final Report**  
**May 1999**

4/29/99

Vineyard  
House #1 Across from site

PH - 6.1 note: started at 8 & decreased continuously  
cond - .095  
turb - 0  
DO - 11.32  
Temp - 14.0°C  
Sal - 0

House #2 Adjacent to site  
509 Wheat Rd  
Mrs Brown

PH - 8.69  
cond - .085  
turb - 0  
DO - 11.24  
Temp - 13.2  
Sal - 0

Almond Beach

Bridge

std

flow

x H<sub>2</sub>O

sl - 0

sign  
Beach Area

PH - 6.4 ✓  
cond - .077  
turb - 0  
DO - 8.66  
Temp - 13.5  
sal - 0



# Alliance Beach

Flow →

sl-1

x H<sub>2</sub>O

sl-1

x soil  
Beach Area

pH = 6.3

Cond - .079

Turb - 0

DO - 8.91

Temp - 15.1

Sal - 0

# BA Beach

Flow ←

sl-1

x H<sub>2</sub>O

sl-1

x soil

Beach Area

pH = 5.85

Cond - .079

Turb - 0

DO - 9.65

Temp - 14.6

Sal - 0

# So. End Union Lake

sd-1

sd-2 x H<sub>2</sub>O

□ Jimmy  
Sun

x soil

□ Jimmy  
Sun

Beach Area

pH - 5.74

Cond - .013

Turb - 0

DO - 9.4

Temp - 15.3

Sal - 0

# Union Lake S+I Club

sd-D

x H<sub>2</sub>O

sd-1

Club House

x Soil

Beach Area

pH - 5.74

Cond - .011

Turb - 0

DO - 9.65

Temp - 16.9

Sal - 0

Union Lake T+S CUD

potable H<sub>2</sub>O

7.0

pH - 7.9

cond - .061

Turb - 0

DO - 11.50

Temp - 14.8

Sal - 0

**APPENDIX B**  
**Analytical Report**  
**Vineland Chemical Site**  
**Final Report**  
**May 1999**

ANALYTICAL REPORT

Prepared by  
Roy F. Weston, Inc.

Vineland Chemical Site  
Vineland, Cumberland County, New Jersey

May 1999

EPA Work Assignment No. 3-195  
WESTON Work Order No. 03347-143-001-3195-01  
EPA Contract No. 68-C4-0022

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Appendix will be furnished on request.		

### Introduction

REAC in response to WA #3-195, provided analytical support for environmental samples collected from the Vineland Chemical Site located in Vineland, Cumberland County, New Jersey as described in the following table. The support also included QA/QC, data review, and preparation of an analytical report containing a summary of analytical methods, results, and QA/QC results.

The samples were treated with procedures consistent with those specified in SOP #1008.

Chain of Custody	Number of Samples	Sampling Date	Date Received	Matrix	Analysis	Laboratory
03503	5	4/29/99	4/30/99	Water	Arsenic	REAC
	15			Soil		
03504	4			Water		
	2			Soil		

### CASE NARRATIVE

#### Data Package 1181

The arsenic (As) percent recoveries for soil samples A19256MS (46%) and A19256MSD (48%) exceeded the QC limits. The As results for soil samples A19251, A19252, A19253, A19255, A19256, A19257, A19259, A19260, A19261, A19263, A19264, A19265, A19267, A19268, A19269, A19274 and A19275 are considered estimated.



## Summary of Abbreviations

AA	Atomic Absorption		
B	The analyte was found in the blank		
BFB	Bromofluorobenzene		
BPQL	Below the Practical Quantitation Limit		
BS	Blank Spike		
BSD	Blank Spike Duplicate		
C	Centigrade		
D	(Surrogate Table) this value is from a diluted sample and was not calculated (Result Table) this result was obtained from a diluted sample		
CLP	Contract Laboratory Protocol		
COC	Chain of Custody		
CONC	Concentration		
CRDL	Contract Required Detection Limit		
CRQL	Contract Required Quantitation Limit		
DFTPP	Decafluorotriphenylphosphine		
DL	Detection Limit		
E	The value is greater than the highest linear standard and is estimated		
EMPC	Estimated maximum possible concentration		
J	The value is below the method detection limit and is estimated		
ICAP	Inductively Coupled Argon Plasma		
IDL	Instrument Detection Limit		
ISTD	Internal Standard		
MDL	Method Detection Limit		
MQL	Method Quantitation Limit		
MI	Matrix Interference		
MRL	Method Reporting Limit		
MS	Matrix Spike		
MSD	Matrix Spike Duplicate		
MW	Molecular Weight		
NA	either Not Applicable or Not Available		
NC	Not Calculated		
NR	Not Requested		
NS	Not Spiked		
% D	Percent Difference		
% REC	Percent Recovery		
PQL	Practical Quantitation Limit		
PPBV	Parts per billion by volume		
QL	Quantitation Limit		
RPD	Relative Percent Difference		
RSD	Relative Standard Deviation		
SIM	Selected Ion Mode		
U	Denotes not detected		
W	Denotes weathered analyte, the results should be regarded as estimated.		
m	cubic meter	kg	kilogram
L	liter	g	gram
dL	deciliter	cg	centigram
mL	milliliter	mg	milligram
μL	microliter	μg	microgram
ng	nanogram	pg	picogram
*	denotes a value that exceeds the acceptable QC limit		

Abbreviations that are specific to a particular table are explained in footnotes on that table

Revision 7/9/98

## Analytical Procedure for Arsenic in Water

### Sample Preparation

A representative 45 mL aliquot of each sample was mixed with 5.0 mL concentrated nitric acid, placed in an acid rinsed Teflon container, capped with a Teflon lined cap, and digested according to SW-846, Method 3015 in a CEM MDS-2100 microwave oven, which was programmed to bring the samples to 160 +/- 4°C in 10 minutes (first stage) and slowly rise to 165-170°C in the second 10 minutes (second stage). After digestion, samples were allowed to cool to room temperature and were transferred to polyethylene bottles. Samples were analyzed for all metals, except mercury, by US EPA SW-846, Method 7000 Atomic Absorption (AA) or Method 6010 Inductively Coupled Argon Plasma (ICAP) procedures.

A reagent blank and a blank spike sample were carried through the sample preparation procedure for each analytical batch of samples processed. One matrix spike (MS) and one matrix spike duplicate (MSD) sample were also processed for each analytical batch or every 10 samples.

### Analysis and Calculations

The AA and ICAP instruments were calibrated and operated according to SW-846, Method 7000/7470/6010 and the manufacturer's operating instructions. After calibration, initial calibration verification (ICV), initial calibration blank (ICB), and QC check standards were run to verify proper calibration. The continuing calibration verification (CCV) and continuing calibration blank (CCB) standards were run after every 10 samples to verify proper operation during sample analysis.

The metal concentrations in solution, in micrograms per liter (µg/L) were read directly from the read-out systems of the instruments. ICAP and Mercury results were taken directly from instrument read-outs. The ICAP results were corrected for digestion volume (45 mL sample + 5 mL nitric acid) prior to instrument read-out; AA read-outs (excluding Mercury) were externally corrected for digestion volume ( $1.1111 \times \text{AA read-out}$ ).

For samples that required dilution to fall within the instrument calibration range:

$$\mu\text{g/L metal in sample} = A [(C+B)/C]$$

where:

A = direct read-out (ICAP and Mercury)

A = corrected read-out (AA)

B = acid blank matrix used for dilution, mL

C = sample aliquot, mL

Results of the analyses are listed in Table 1.1.

## Analytical Procedure for Arsenic in Soil

### Sample Preparation

A representative 1-2 g (wet weight) sample, weighed to 0.01 g accuracy, was mixed with 10 mL 1:1 nitric acid, placed in a clean beaker and digested in nitric acid and hydrogen peroxide according to SW-846, Method 3050. The final reflux was either nitric acid or hydrochloric acid depending on the metals to be determined. After digestion, the samples were allowed to cool to room temperature and transferred to 100 mL volumetric flasks and diluted to volume with ASTM Type II water. The samples were analyzed for all metals, except mercury, by USEPA SW-846, Method 7000 (Atomic absorption) or Method 6010 (Inductively Coupled Argon Plasma-ICAP) procedures.

A separate sample was used to determine total solids.

A reagent blank and a blank spike sample were carried through the sample preparation procedure for each batch of samples processed. One matrix spike (MS) and one matrix spike duplicate (MSD) were analyzed for each batch or for every ten samples.

### Analysis and Calculations

The instruments were calibrated and operated according to SW-846, Method 7000/7471/6010 and the manufacturers operating instructions. After calibration, initial calibration verification (ICV), initial calibration blank (ICB) and quality control check standards were run to verify proper calibration. The continuing calibration verification (CCV) and continuing calibration blank (CCB) were run after every ten samples to assure proper operation during sample analysis.

The metal concentrations in solution, in micrograms per liter ( $\mu\text{g/L}$ ) were taken from the read-out systems of the Atomic Absorption instruments. The results were converted to milligrams per kilogram ( $\text{mg/kg}$ ) by correcting the reading for the sample weight and percent solids. The ICAP results ( $\text{mg/kg}$ ) were corrected for sample weight prior to instrument read-out; the instrument read-out was then corrected for percent solids.

Final concentrations, based on wet weight are given by:

$$\text{mg metal/kg sample} = [(A \times V) / W] \times DF \times CF$$

where:

A = Instrument read-out ( $\mu\text{g/L}$ , AA;  $\text{mg/kg}$ , ICAP)  
V = final volume of processed sample (mL, AA; 1.00 ICAP)  
W = weight of sample (g, AA; 1.00 ICAP)  
DF = Dilution Factor (1.00 for no dilution)  
CF = conversion factor (0.001, AA; 1.00, ICAP)

For samples that required dilution to be within the instrument calibration range, DF is given by:

$$DF = (C+B)/C$$

where:

B = acid blank matrix used for dilution (mL)  
C = sample blank aliquot (mL)

Final concentrations, based on dry weight, are given by:

$$\text{mg/kg(dry)} = [\text{mg/kg (wet)} \times 100] / S$$

where

S = percent solids

The results are listed in Table 1.2.

Table 1.2 Results of the Analysis for Arsenic in Soil  
WA# 3195 Vineland Chemical Site  
Results Based on Dry Weight

Parameter: Analysis Method:		Arsenic AA-Furnace		
Client ID	Location	Percent Solids	Conc mg/kg	MDL mg/kg
Method Blank	Lab	NA	U	0.50
A19251	Almond-S	82.91	0.43	0.39
A19252	Almond-Sd-U	76.51	3.4	0.44
A19253	Almond-Sd-D	80.00	1.9	0.41
A19255	Alliance-S	87.68	0.59	0.41
A19256	Alliance-Sd-U	82.49	10	0.42
A19257	Alliance-Sd-D	85.09	3.4	0.41
A19259	BA Beach-S	99.53	U	0.47
A19260	BA Beach-Sd-U	79.54	6.6	0.41
A19261	BA Beach-Sd-D	77.98	1.7	0.44
A19263	So. End Union Lake-S	99.57	U	0.48
A19264	So. End Union Lake-Sd-U	74.95	11	0.38
A19265	So. End Union Lake-Sd-D	71.90	5.1	0.42
A19267	Union Lake-S	86.25	2.6	0.41
A19268	Union Lake-Sd-U	77.54	6.0	0.47
A19269	Union Lake-Sd-D	82.51	2.8	0.42
A19274	Field Blank-S	100.00	U	0.48
A19275	Field Blank-Sd	100.00	U	0.48

**Table 1.1 Results of the Analysis for Arsenic in Water  
WA# 3195 Vineland Chemical Site**

Parameter:  
Analysis Method:

Arsenic  
AA-Furnace

Client ID	Location	Conc ug/L	MDL ug/L
Method Blank	Lab	U	2.2
A19254	Almond-SW	110	2.2
A19258	Alliance-SW	240	2.2
A19262	BA Beach-SW	11	2.2
A19266	So. End Union Lake-SW	15	2.2
A19270	Union Lake-SW	5.8	2.2
A19271	Union Lake-P	U	2.2
A19272	House #1-P	U	2.2
A19273	House #2-P	U	2.2
A19276	Field Blank-SW	U	2.2

## QA/QC for Arsenic

### Results of the QC Standard Analysis for Arsenic in Water

The QC standard TMAA#1 was used to check the accuracy of the calibration curve. The percent recovery for the arsenic found in the QC standard listed in Table 2.1, was 97 and within the 95% confidence interval limit.

### Results of the MS/MSD Analysis for Arsenic in Water

Sample A19258 was chosen for matrix spike/matrix spike duplicate (MS/MSD) analysis. The percent recoveries, listed in Table 2.2, were 76 and 99. Both recoveries were within QC limits. The relative percent difference (RPD), also listed in Table 2.2, was 27 and outside the QC limits.

### Results of the Blank Spike Analysis for Arsenic in Water

The percent recovery for the blank spike arsenic, listed in Table 2.3, was 99 and within QC limits.

### Results of the QC Standard Analysis for Arsenic (Soil)

The QC standard TMAA#1 was used to check the accuracy of the calibration curve. The percent recovery for the arsenic found in the QC standard listed in Table 2.4, was 96 and within the 95% confidence interval limits.

### Results of the MS/MSD Analysis for Arsenic in Soil

Samples A19255, A19256, and A19257 were chosen for matrix spike/matrix spike duplicate (MS/MSD) analysis. The percent recoveries, listed in Table 2.5, ranged from 46 to 83. Four out of 6 recoveries were within QC limits. The relative percent differences (RPDs), also listed in Table 2.5, ranged from 2 to 10. All 3 RPDs were within QC limits.

### Results of the Blank Spike Analysis for Arsenic in Soil

The percent recovery for the blank spike arsenic, listed in Table 2.6, was 95 and within QC limits.

Table 2.1 Results of the QC Standard Analysis for Arsenic in Water  
WA# 3195 Vineland Chemical Site

Metal	Date Analyzed	Quality Control Standard	Conc. Recovered ug/L	Certified Value ug/L	95 % Confidence Interval	% Recovery
Arsenic	04/30/99	TMAA #1	48.53	50	41.9-55.9	97

Table 2.2 Results of the MS/MSD Analysis for Arsenic in Water  
WA# 3195 Vineland Chemical Site

Sample ID: A19258

Metal	Sample Conc µg/L	MS Spike Added µg/L	MS Conc µg/L	MS % Rec	MSD Spike Added µg/L	MSD Conc µg/L	MSD % Rec	RPD	Recommended QC Limits	
									% Rec	RPD
Arsenic	244	55.6	299	99	55.6	286	76	27 *	75-125	20



**Table 2.3 Results of the Blank Spike Analysis for Arsenic in Water  
WA# 3195 Vineland Chemical Site**

<b>Metal</b>	<b>Spiked Conc ug/L</b>	<b>Recovered Conc. ug/L</b>	<b>% Recovery</b>	<b>Recommended QC Limit % Rec</b>
<b>Arsenic</b>	<b>55.6</b>	<b>55.1</b>	<b>99</b>	<b>75-125</b>

Table 2.4 Results of the QC Standard Analysis for Arsenic (Soil)  
WA# 3195 Vineland Chemical Site

Metal	Date Analyzed	Quality Control Standard	Conc. Recovered ug/L	Certified Value ug/L	95 % Confidence Interval	% Recovery
Arsenic	05/03/99	TMAA #1	48	50	41.9-55.9	96

Table 2.5 Results of the MSMSD Analysis for Arsenic in Soil  
 WA# 3195 Vineland Chemical Site  
 Results Based on Dry Weight

Sample ID: A19255

Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits	
									%Rec	RPD
Arsenic	0.587	4.04	3.81	75	4.19	3.79	76	2	75-125	20

Table 2.5 (cont.) Results of the MS/MSD Analysis for Arsenic in Soil  
 WA# 3185 Vineland Chemical Site  
 Results Based on Dry Weight

Sample ID: A19256

Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits	
									%Rec	RPD
Arsenic	10.4	4.36	12.4	46 *	4.39	12.5	48 *	4	75-125	20

Table 2.5 (cont.) Results of the MS/MSD Analysis for Arsenic in Soil  
 WA# 3195 Vineland Chemical Site  
 Results Based on Dry Weight

Sample ID: A19257

Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits %Rec	RPD
Arsenic	3.44	4.29	6.99	83	4.32	6.66	75	10	75-125	20

**Table 2.6 Results of the Blank Spike Analysis for Arsenic in Soil  
WA# 3195 Vineland Chemical Site**

<b>Metal</b>	<b>Spiked Conc mg/kg</b>	<b>Sand Blk Conc. mg/kg</b>	<b>Recovered Conc. mg/kg</b>	<b>% Recovery</b>	<b>Recommended QC Limit % Rec</b>
Arsenic	4.95	U	4.71	95	75-125

REAC, Edison, NJ  
(908) 321-4200  
EPA Contract 68-C4-0022

# CHAIN OF CUSTODY RECORD

Project Name: Vineland Chemical  
Project Number: 03347-143-001-3195-01  
RFW Contact: Jim Boyle Phone: 732-494-4004

No: 03503

SHEET NO. 1 OF 2

043099-

## Sample Identification

## Analyses Requested

REAC #	Sample No.	Sampling Location	Matrix	Date Collected	# of Bottles	Container/Preservative	Analyses Requested
-109	A19251	Almond - S	S	4/29/99	1	8 oz jar / 4°C	Arsenic ✓
110	A19252	Almond - Sd-U	Sd				
111	A19253	Almond - Sd-D	Sd				
112	A19254	Almond - Su	Su			1 L poly / 4°C / HNO <sub>3</sub>	
113 *	A19255	Alliance - S	S			8 oz jar / 4°C	
114 *	A19256	Alliance - Sd-U	Sd				
115 *	A19257	Alliance - Sd-D	Sd				
116 *	A19258	Alliance - Su	Su		3	1 L poly / 4°C / HNO <sub>3</sub>	
117	A19259	BA Beach - S	S		1	8 oz jar / 4°C	
118	A19260	BA Beach - Sd-U	Sd				
119	A19261	BA Beach - Sd-D	Sd				
120	A19262	BA Beach - Su	Su			1 L poly / 4°C / HNO <sub>3</sub>	
121	A19263	So. End Union Lake - S	S			8 oz jar / 4°C	
122	A19264	So. End Union Lake - Sd-U	Sd				
123	A19265	So. End Union Lake - Sd-D	Sd				
124	A19266	So. End Union Lake - Su	Su			1 L poly / 4°C / HNO <sub>3</sub>	
125	A19267	Union Lake - S	S			8 oz jar / 4°C	
126	A19268	Union Lake - Sd-U	Sd				
127	A19269	Union Lake - Sd-D	Sd				
128	A19270	Union Lake - Su	Su			1 L poly / 4°C / HNO <sub>3</sub>	

Matrix:

SD - Sediment  
DS - Drum Solids  
DL - Drum Liquids  
X - Other  
PW - Potable Water  
GW - Groundwater  
SW - Surface Water  
SL - Sludge  
S - Soil  
W - Water  
O - Oil  
A - Air

Special Instructions:

\* MS/MSD

FOR SUBCONTRACTING USE ONLY

FROM CHAIN OF CUSTODY #

GA:R

Items/Reason	Relinquished By	Date	Received By	Date	Time	Items/Reason	Relinquished By	Date	Received By	Date	Time
all analyses	Michael Boyle	4/29/99	David Angewy	4/30/99	8:30	All/Analyses	David Angewy	4/30/99	Y. Exame	5/10/99	7:00

**REAC, Edison, NJ**

**(908) 321-4200**

**EPA Contract 68-C4-0022**

### CHAIN OF CUSTODY RECORD

Project Name: Disland Chemical

Project Number: 03347-143-001 3195-01

RFW Contact: Jen Boyce Phone: 732-494-4004

No: 03504

**SHEET NO. 2 OF 2**

043099-

### Sample Identification

### Analyses Requested

[illegible]

**Matrix:**

SD -	Sediment	PW -	Potable Water	S -	Soil
DS -	Drum Solids	GW -	Groundwater	W -	Water
DL -	Drum Liquids	SW -	Surface Water	O -	Oil
X -	Other	SL -	Sludge	A -	Air

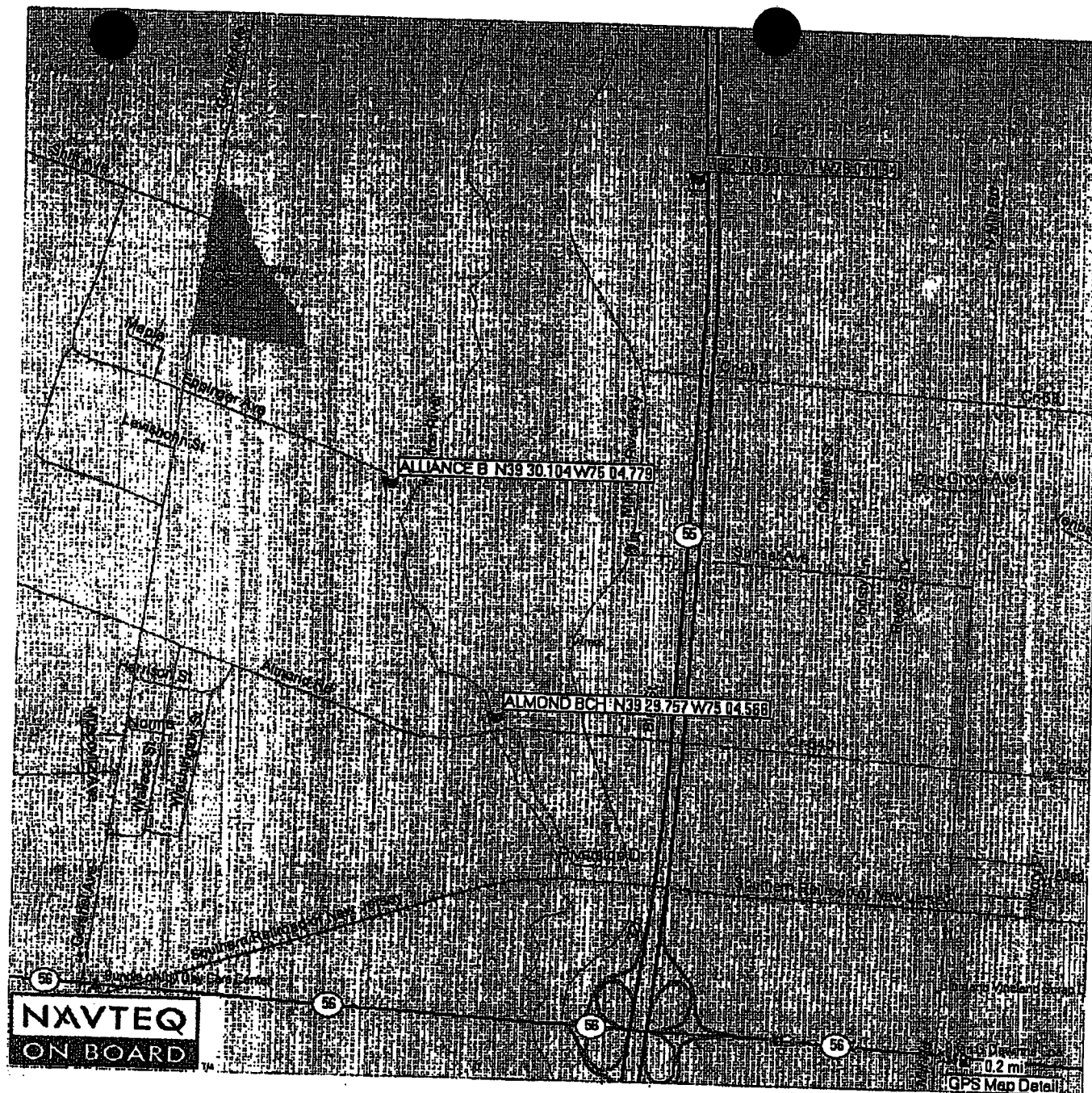
**Special Instructions:**

**FOR SUBCONTRACTING USE ONLY**

**FROM CHAIN OF  
CUSTODY #**

[illegible]





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